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MONOGRAPH

OF THE

COLLEMBOLA AND THYSANURA.

BY

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PREFACE.

THE animals which form the subject of this work were first grouped together by Latreille under the name of THYSANURA: to me, on the contrary, they appear to form two distinct orders, for one of which I have proposed the term COLLEMBOLA. They have hitherto been much neglected by English naturalists. And they from their small size, and the delicacy of their structure, which renders them uninteresting to collectors, together with the absence of well-marked metamorphoses, this is, perhaps, not surprising; yet the two groups are in many respects of singular interest.

It is unfortunate that the two naturalists, M. Nicolet and M. l'Abbé Bourlet, who have of late years contributed most to our knowledge of the COLLEMBOLA, should have published the results of their labours almost simultaneously; and as they worked quite independently of one another, the consequence has been to complicate greatly those difficulties of nomenclature which, owing to the brevity of early descriptions, were already sufficiently embarrassing.

Several, for instance, of Linnæus' specific characters would apply to more than one species, and even to more than one genus. I have reason, therefore, to be

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very grateful to M. Tullberg, who has been so good as to send me several Swedish species, and has thus enabled me to form in these cases a more decided opinion than could otherwise have been possible. I must also express my thanks to Mr. McIntire for much assistance in the collection of English species, as well as for many valuable suggestions.

The scales of the THYSANURA and COLLEMBOLA have long been a subject of much interest to microscopists.

Through the kindness of Mr. J. Beck I am able to give some beautiful plates of scales drawn by his brother, the late Mr. R. Beck. Mr. J. Beck has added a detailed description of these plates, as well as some interesting remarks on the subject, which will be found in an Appendix. I regret that I did not receive these descriptions in time to introduce them under the heads of the several species.

In the present work I have confined myself to the existing species, as I have not had the opportunity of studying any extinct representatives either of the COLLEMBOLA or THYSANURA. If, however, the views

by swollen antennæ, for which they have proposed the name *Paidium*. They likewise refer to the THYSANURA two doubtful species, for which they have proposed two new genera, *Acreagus* and *Glessaria*. The latter has been regarded by some as a neuropterous, by others as a coleopterous, larva; while *Acreagus* has been referred by some to the *Hemiptera*, a view in which I am disposed to concur.

Whatever shortcomings may be found in this work, and while no one can be more sensible of them than myself, I believe that the plates must meet with general approval. Of the anatomical drawings, indeed, which were mostly made by myself with the aid of the camera lucida, I will say no more than that I believe they will be found to be correct; but the representations of the species, and the general execution of the plates, are the work of Mr. Hollick, a gentleman who is unfortunately deaf and dumb, but in whom these terrible disadvantages have been overcome by natural genius. I believe this is the first work which has ever been illustrated by a deaf and dumb artist. It will be seen that Mr. Hollick has spared himself no labour or pains. I feel much indebted to him for the conscientiousness with which he has reproduced the minute details of the originals, as well as for the beauty and accuracy of his work.

HIGH ELMS, DOWN, KENT:
13th March, 1872.

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INTRODUCTION.

THE COLLEMBOLA and THYSANURA, which form the subject of the present work, have hitherto been but little studied in this country. Yet if a fallen bough be examined, a heap of moss shaken over a pocket-handkerchief, or any long herbage swept with a hand-net, the naturalist will not fail to find, together with numerous beetles, flies, and other insects, certain delicate, hexapod, active little creatures; the majority of which will endeavour to escape not only running with agility, but also springing with considerable force, by means of a sub-abdominal, forked organ, which, commencing near the posterior end of the body, reaches forward, in most cases, almost as far as the thorax. These constitute the Linnæan genus *Podura*, or Springtail; subsequently combined by Latreille with *Lepisma*, and elevated to the rank of an order under the name THYSANURA; but which, for reasons to be given presently, I have again proposed to separate from the *Lepismidæ*, and to call COLLEMBOLA, leaving Latreille's name THYSANURA for the other portion of his group.

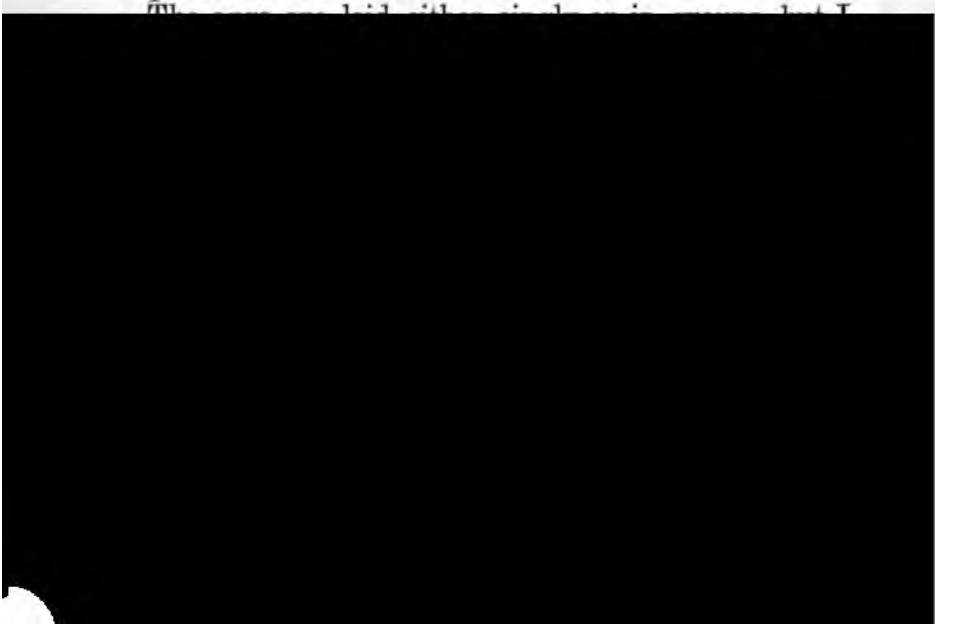
Both the THYSANURA and the COLLEMBOLA frequent dark places; but while the former prefer dry walls, heaps of stones, or warm rooms—in short, warm and dry places—the latter, with few exceptions, can only live in moist situations, and suffer little from cold.

Owing to their very general intolerance of light, we know little as yet with reference to the habits of the

group, though some particulars will be found under the head of the different species. As a general rule, they seem to take little notice of one another; but in the case of *Smynthurus luteus*, a very common species in our meadows, the males are very attentive to the females, and caress them lovingly with their antennæ.

Some species, as, for instance, *Smynthurus aquaticus* and *Podura aquatica*, live on the surface of ponds; some are found on the sea-shore; others, as *Seira domestica*, in houses; but the majority of species frequent fungi, decaying leaves, moss, or loose soil: in fact, wherever there is any decaying vegetable matter, COLLEMBOLA may be found in abundance.

Several species of *Smynthurus* and *Papirius* curiously resemble certain small spiders. Thus, the markings and colour of *P. ornatus* are very like those of certain species of *Theridion* and *Epeira;* while *S. fuscus* so closely resembles certain small brown spiders that I have myself, when collecting, been more than once deceived. We have here, therefore, I think, a case of that "mimicry" which has been so well described by Mr. Bates and Mr. Wallace, and I cannot doubt that this similarity to spiders tends to protect *Smynthurus* and *Papirius* from attack.



mation with reference to extra European species is as yet very meagre.

The synonymy of the group is unfortunately much involved. This has arisen partly from the fact that the descriptions given by the earlier writers, excepting always De Geer, are so short that it is in many cases impossible to determine satisfactorily the species, or even the genus; partly from the fact that some species vary very much in colour, and partly from the accident that Bourlet and Nicolet, who have described a considerable number of species, published the results of their labours almost simultaneously, and without being aware of one another's writings. Under these circumstances I have thought it desirable to give lists of the names used by some of the principal writers on the group, together with those by which I think the species should be known. In some cases, however, the species are unfortunately quite undeterminable from the characters given, and others, probably, are mere varieties of one another.

The first memoir on the group to which I think it necessary to refer was published by De Geer[1] under the title "Experimenta et Observationes de parvulis insectis, agili saltu corpuscula sua in altum levantibus, quibus *Poduræ* nomen est, exhibitæ." He describes in detail, and with his usual accuracy, four species, viz. *Podura campestris nigra*, our *Isotoma arborea*; *Podura campestris cinerea* = *Degeeria nigromaculata*; *Podura aquatica nigra*, still known as *P. aquatica*; and *Podura aquatica cinerea*, which is our *Isotoma stagnorum*. The memoir is illustrated by four plates.

Three years later De Geer published a second memoir,[2] in which he described and figured the first species of *Smynthurus*, *S. fuscus*. He recognised its affinities to the *Poduridæ*, and described it as follows:—"*Podura* fusca, globosa, nitida, antennis longis, articulis plurimis."

[1] 'Acta Soc. Reg. Sci. Upsaliensis,' 1740, p. 48.
[2] 'Kongl. Swenska Wet. Acad. Hand.,' 1743, p. 296.

Linnæus, in the first edition of the 'Fauna Suecica,' described nine species of *Podura*, namely, *P. viridis*, *atra*, *globosa fusca*, *teres plumbea*, *nivalis*, *arborea nigra*, *aquatica nigra*, *viatica*, and *terrestris alba*.

P. viridis seems undoubtedly to be our *Smynthurus viridis*. *P. atra* is more doubtful; his description is, "*P. atra*, abdomine subgloboso, antennis longitudine corporis; apice albis." In the 'Systema Naturæ,' on the contrary, these characters are given under the name of *P. polypoda*, and *P. atra* is made synonymous with De Geer's *P. fusca*. On the whole, I am disposed to regard the *P. atra* of the 'Faun. Suec.' (*P. polypoda* of the 'Sys. Nat.'), as our *Papirius polypodus*. This species occurs in Sweden, whence M. Tullberg has been so kind as to send me some specimens. It has white tips to the antennæ; but, on the other hand, in this country it is rather violet than black.

P. globosa fusca nitida is, in all probability, our *Smynthurus fuscus*. *P. teres plumbea* has been generally regarded as the species which must, I think, now bear the name of *Tomocerus plumbeus*. It has been so considered by most of those who have written on the group, but the determination seems to me very doubtful. *P. nivalis* is still known by the same name.

P. arborea nigra is probably the *Isotoma arborea* of

It was, probably, a young *Isotoma*. On the contrary, the *P. fimetaria* of the 'Sys. Nat.' is described simply as *P. terrestris alba;* but he adds "non salit." It is probable, therefore, that the *P. fimetaria* of the 'Sys. Nat.,' though not that of the 'Faun. Suec.,' is the species now known as *Lipura fimetaria*. The following is a list of the species with the names used in the present work:

LINNÆUS, 'Fauna Suecica,' 1746.

Linn.		*Mihi.*
Podura viridis	=	Smynthurus viridis.
„ atra		Papirius polypodus?
„ globosa fusca nitida		„ fuscus.
„ teres plumbea		Tomocerus plumbeus?
„ nivalis		„ nivalis.
„ arborea nigra		Isotoma arborea.
„ aquatica nigra		Podura aquatica.
„ viatica		„ viatica?
„ terrestris alba		Young Isotoma.

In the second edition of the 'Fauna Suecica,' published in 1761, Linnæus omits the *P. viatica*, with reference to which even in the first he had expressed a doubt whether it was not identical with *P. aquatica*. On the other hand, he adds two new species, *P. cincta*, which is evidently *Orchesella cincta;* and *P. ambulans*, which is described as "*P. ambulans* alba, furca extensa;" while the somewhat longer description given in the 'Syst. Nat.' is, "*P. alba*, cauda bifida extensa obtusa. Corpus cylindricum, reliquis longius, album, molle. Punctum fuscum supra anum. Cauda setis 2 extensis, longitudine ½ corporis. Non salit." This species seems, from the above description, to have been a *Campodea*. On the other hand, De Geer's *P. ambulans* does not answer to either of the above descriptions, but appears to be our *Lipura ambulans*. It does not seem to have been noticed by any writer that *Lipura ambulans* is mentioned in the first edition of the 'Faun. Suec.,' though not among the *Podurœ*, being described as a *Pediculus*, although Linnæus adds "facies omnino *Podurœ*."

Geoffroy,[1] in 1762, placed *Podura* and *Forbicina* (Lepisma) between *Pediculus* (the Louse) and *Pulex* (the Flea). He divided the *Podurœ* into—1st, Globulosæ; and 2nd, Longæ. Of the first group he described three species under the names *P. atra*, *P. viridis*, and *P. polypoda*.

His *P. viridis* is evidently the *Smynthurus viridis* of subsequent authors, but *P. atra* and *polypoda* are more difficult to identify. I have sometimes been disposed to think that they were both founded on the common brown *Smynthurus*, but it is possible that *P. polypoda* may be my *Papirius fuscus*. Of the "Podures allongées" Geoffroy describes seven species, namely, *P. villosa*, which is evidently an *Orchesella*, and probably *O. villosa*; *P. livido-lutea*, which is probably *Degeeria nivalis*, or perhaps, as Geoffroy himself suggests, a young specimen of *P. villosa*; *P. annulata*, which appears to be *Orchesella cincta*; *P. viatica*; *P. aquatica*; *P. plumbea*; and *P. violacea*, which may be a *Lepidocyrtus*, or, as Geoffroy himself suggests, a young specimen of *P. plumbea*. *Lepidocyrtus* is, however, so common that I incline to the first hypothesis.

Of *Forbicina* Geoffroy described two species, *F. plana*, and *F. cylindrica*.

He characterised the genus *Podura* as follows:—

Podura fusca	=	Papirius fuscus.
„ villosa		Orchesella villosa.
„ livido-lutea		Degeeria nivalis, *or* an
„ nigra		Orchesella cincta.
„ viatica		Isotoma viatica.
„ aquatica		Podura aquatica.
„ plumbea		Tomocerus plumbeus.
„ violacea		„ „ ?

Linnæus, in the twelfth edition of the 'Systema Naturæ' (1767), placed *Lepisma* and *Podura* at the head of the Aptera, followed by *Termes* and *Pediculus*. *Lepisma* he characterised as follows:—"Pedes VI cursorii. Os palpis 2 setaceis et 2 capitatis. Cauda setosa: setis extensis. Corpus squamis imbricatum."

Of *Podura* he gave the following description:—"Pedes VI cursorii. Oculi 2 compositi ex octonis. Cauda bifurca, saltatrix, inflexa. Antennæ setaceæ elongatæ."

Of *Lepisma* he described three species, *L. saccharina*, *L. polypoda*, and *L. terrestris*. Of *Podura* he was acquainted with fourteen, namely, *P. viridis*, *polypoda*, *atra*, *plumbea*, *minuta*, *nivalis*, *vaga*, *arborea*, *villosa*, *cincta*, *pusilla*, *aquatica*, *fimetaria*, and *ambulans*.

LINNÆUS, 'Sys. Naturæ,' ed. xii.

Podura viridis	=	Smynthurus viridis.
„ polypoda		Papirius polypodus.
„ atra		Smynthurus fuscus.
„ plumbea		Tomocerus plumbeus.
„ minuta		?
„ nivalis		Degeeria nivalis ?
„ vaga		Orchesella cincta.
„ arborea		Isotoma arborea.
„ villosa		Orchesella villosa.
„ cincta		„ cincta.
„ pusilla		Lepidocyrtus pusillus.
„ aquatica		Podura aquatica.
„ fimetaria		Lipura fimetaria.
„ ambulans		Campodea staphylinus ?

Fabricius, in his 'Systema Entomologiæ,'[1] places *Lepisma* and *Podura* among his SYNISTATA, between *Oniscus* and *Ephemera*. He describes five species of *Lepisma*, and sixteen of *Podura*, the latter being the

[1] 'Systema Entomologiæ,' 1775.

same as those of Linnæus, with the addition of *P. annulata* and *P. lignorum*.

Müller, in 1776,[1] described four species of *Lepisma* and seven of *Podura*. His descriptions are very short, and, though characteristic as far as they go, sometimes leave even the genus doubtful. In several cases I cannot even guess at the species which is intended. Some of his descriptions appear to have been taken from injured specimens. Thus, *Lepisma terrestris* is described simply as "nuda, cauda triplici." But unfortunately, all the *Lepismidæ* have scales and three caudal appendages. The first portion of the description, therefore, applies to no *Lepisma;* the rest to them all. Possibly he may have had a *Nicoletia* before him, but that genus has not yet been recognised in Denmark. Again, *Podura motitans*, *P. nemoralis*, *P. argenteo-aurata*, and *P. cærulea* are so shortly and insufficiently described that I cannot even guess to what genus they belong.

Müller.		*Mihi.*
Lepisma saccharina	=	Lepisma saccharina.
„ terrestris		—
„ polypoda		Machilis polypoda.
„ minuta		Lepismina minuta.
Podura viridis		Isotoma viridis.

Schrank,[1] in 1781, recorded the following nine species, viz. *Podura alba*, *viridis*, *nivalis*, *arborea*, *plumbea*, *villosa*, *aquatica*, *fimetaria*, and *monura*. He places them all under the genus *Podura*, and his descriptions of the first eight are word for word the same as those of Linnæus.

P. monura is described as occurring with and much resembling *O. fimetaria*. It is, however, rarer, greyer, and slightly smaller; the antennæ are four-jointed, the eyes black; the insect is covered with hairs, those on the body being the longest. The chief peculiarity, however, lies in the tail, which is three-jointed, but not double. Moreover, the third segment is described as retractile within the second. The animal jumps, but not very actively. Subsequent writers do not appear to have met with any species answering to this description. I am disposed to think that Schrank must have had before him a specimen with an accidentally mutilated tail.

De Geer, in the seventh vol. of the edition of his great work published in 1782,[2] treats of *Lepisma* and *Podura* between the flea and the white ant. Of *Lepisma*, or, as he calls the genus, *Forbicina*, he mentions only one species, the common *L. saccharina*.

Podura he divides, like Geoffroy, into two families, one containing *Podura* and the other long species, the second corresponding to the *Smynthuridæ*. Of the *Poduridæ* he describes *P. arborea*, *nivalis*, *aquatica*, *aquatica grisea*, *plumbea*, and *ambulans*. Of the *Smynthuridæ* he only knew the *S. ater*, which, however, he describes with his usual accuracy. Of these the *P. aquatica grisea* is the only one not in the 'Systema Naturæ.' As already mentioned, however, his *P. ambulans* is not the *P. ambulans* of Linnæus.

De Geer's figures enable us to determine several of Linnæus's species which it would be otherwise impos-

[1] 'Enumeratio insectorum Austriæ indigenorum.'
[2] 'Geschichte der Insecten,' vol. vii, p. 8.

sible to fix satisfactorily, as the descriptions given by Linnæus are quite insufficient for the purpose.

De Geer, 'Gesch. Ins.,' vol. vii.

Podura arborea nigra	=	Isotoma arborea.
„ „ grisea		Degeeria annulata.
„ aquatica nigra		Podura aquatica.
„ „ grisea		Isotoma stagnorum.
„ plumbea		Tomocerus plumbeus.
„ ambulans		Lipura ambulans.
„ globosa fusca		Smynthurus fuscus.

In 1783 O. Fabricius published[1] a memoir on the group, in which he describes seven species—*P. humicola*, *P. hypnorum*, *P. cincta*, *P. gigas*, *P. longicornis*, *P. crystallina*, and *P. minuta*, the latter being, I think, *Papirius nigromaculatus*.

Fabricius, in 1793,[2] places the genus *Podura* (with *Lepisma*) at the head of the SYNISTATA, and immediately before *Ephemera*, following *Gryllus*, with which he closes the *Ulonata*. He records seventeen species, which are the same as the first sixteen in Gmelin's ed. of the 'Sys. Nat.' (with the addition of *P. signata*), and are described in the same words; adding, however, the *P. annulata* and *P. lignorum*, which he describes as "plumbea capite thorace pedibus furcâque pallidis." This species, I think, it is impossible to

He characterises the THYSANURA as possessing "Os mandibulis, palpis, labro et labio, corpus sæpius squamosum aut hirsutum, errans, ano setoso caudave furcata. Insecta cursu veloci, vel saltatorii."

He divides the THYSANURA into two families :[1]

Ordo Primus.

Thysanoura. *Thysanoures.*

THYSANOURA	Palpi exserti, elongati: antennæ a basi ad apicem multiarticulatæ, articulis innumeris, brevissimis; cauda setis tribus exsertis.	*Familia prima.* — Lepismenæ. Lépismènes.
	Palpi nec exserti, nec facile conspicui: antennæ articulis paucis, aut apice tantum multiarticulatæ; cauda furcata, sub abdomine inflexa.	*Familia secunda.* — Podurellæ. Podurelles.

Subsequently in 1810[2] he placed the THYSANURA between the MYRIAPODA and PARASITA, as the third order of the ARACHNIDA. He distinguished two genera of *Lepismidæ*, *Lepisma* and *Machilis*, and two of *Poduridæ*, separating the globular species under the name of *Smynthurus*, which has since been generally adopted.

Lamarck, in his 'Animaux sans Vertèbres,' adopts the group THYSANURA, of which, however, he only mentions six species, namely, *Smynthurus fuscus*, *S. viridis*, and *S. signatus*, *Podura aquatica*, *P. villosa*, and *P. plumbea*.

The 'Journal of the Academy of Philadelphia' for 1820 contains a short paper by Mr. Say on the THYSANURA of the United States. Besides a species of *Machilis*, he describes three species of *Podura* and one of *Smynthurus*. He gives, unfortunately, so few particulars that it will probably not be very easy for American naturalists to identify them, nor is it, I think, possible even to conjecture how far they are distinct from our European species. His *P. iricolor* is

[1] 'Genera Crustaceorum et Insectorum.'

[2] 'Considérations générales sur l'ordre naturel des Crustacés, des Arachnides et des Insectes.'

probably a *Lepidocyrtus; P. fasciata*, a *Degeeria;* and *P. bicolor*, perhaps, an *Isotoma.*

In 1831 M. Dufour described,[1] in the 'Ann. des Sci. Nat.,' two new species of *Lepismidæ.*

Latreille's memoir on the "Organisation extérieure et comparée des Insectes de l'ordre des *Thysanoures*," in the 'Nouvelles Annales du Muséum d'histoire naturelle,' 1832, is principally occupied with a description of the external anatomy of the *Lepismidæ.* As regards the *Poduridæ*, he very justly questions the accuracy of the description of their manducatory organs given by Fabricius, which, indeed, he does not hesitate to characterise as "absolument fictive." He is, however, himself in error when he considers the gastric tube as the external generative organ.

Boisduval and Lacordaire, in their 'Faun. Ent. des Env. de Paris,'[2] adopted Latreille's group of *Thysanoures*, and repeat the specific descriptions given by previous writers.

The first volume of the 'Transactions of the Entomological Society of London' contains a very valuable memoir[3] on Irish THYSANURA by Mr. Templeton. This paper is accompanied by two excellent plates.

He founded two new genera, *Orchesella* and *Achorutes*,

Podura plumbea	=	Tomocerus plumbeus.
„ nitida		Templetonia crystallina.
„ nigromaculata		Degeeria annulata.
„ albocincta		„ albocincta?
„ cingula		Orchesella cincta.
„ fuliginosa		Isotoma arborea.
„ stagnorum		„ palustris.
Achorutes dubius		Achorutes dubius.
„ muscorum		Anoura muscorum.
Smynthurus viridis		Papirius Saundersii.
„ atra		Smynthurus fuscus.
„ signata		Papirius nigromaculatus.

His *P. cingula* is, I think, founded on a young specimen of *O. cincta*. His *S. viridis* is not the species so named by Fabricius and other authors, but *Papirius ornatus*. So also his *S. signata* is not the *S. signata* of old authors, but my *Papirius nigromaculatus*.

Mr. Westwood has prefaced Mr. Templeton's paper by some valuable introductory remarks. He points out the interesting character of the group, both from its structural peculiarities and also "from the rank which they hold amongst annulose beings, being one of those *quæstiones vexatæ* which it is most desirable should be set at rest."

Burmeister,[1] in 1835, placed the THYSANURA between the *Liotheidæ* and *Blattidæ*. He gives for the *Poduridæ* the following characters:—"Antennæ corpore breviores, filiformes; oculi compositi nulli; partes oris absconditæ, palpi 4 brevissimi, inarticulati, dentati, setigeri; tarsi 1—2 articulati."

He adopted the genera *Achorutes*, *Podura*, *Orchesella*, and *Smynthurus*, adding, as already mentioned, a fifth, "*Lipura*," for the species without a spring tail. This was a decided improvement. He also proposed the name *Choreutes* for the species of *Podura* with long antennæ, at the head of which he placed Linnæus's *P. plumbea*. This name has not been adopted by subsequent writers, having been already used for a genus of insects.

In the 'Comptes Rendus' for 1836[2] M. Guérin

[1] 'Handbuch der Entomologie.'

[2] 'Comptes Rendus de l'Acad. des Sciences,' 1836, vol. ii, p. 595.

published a short notice on the abdominal appendages of *Machilis polypoda*, which he compares with the branchiæ of Crustacea, a comparison which, he says, "me semble d'autant plus probable, que Latreille n'a pas trouvé de traces de stigmates sur les nombreux individus qu'il a eu occasion d'observer."

In the year 1839 M. l'Abbé Bourlet published his "Mémoire sur les Podures."[1] He described shortly but with much accuracy their antennæ, eyes, and other external characteristics.

He divided the Linnean genus *Podura* into five groups, characterised as follows:

PODURES.

Couvertes d'écailles.	Antennes longues de trois articles, le dernier beaucoup plus long que les autres, yeux formés de six ocelles . .	1er genre, ***Macrotome.***
	Antennes courtes, de quatre articles, huit ocelles . .	2e genre, ***Lépidocyrte.***
Sans écailles.	Antennes de longueur moyenne, variant de deux à cinq articles inégaux, six ocelles .	3e genre, *Hetérotome.*
	Antennes courtes, constamment de quatre articles à peu près égaux entre eux, dix ou huit ocelles	4e genre, *Isotome.*
	Antennes très-courtes, de quatre articles, corps noir, fort petit, organ du saut attaché	

toma offers, he says, "une anomalie remarquable. Bienque leurs antennes soient evidemment conformées sur un même type, non seulement le nombre de leurs articles est souvent variable, mais ce nombre n'est pas toujours égal dans le même individu." This difference between the two antennæ, even of the same specimen, ought to have prevented him from characterising a genus on such merely accidental characters.

His last genus, *Hypogastrura*, is founded on the *Podura aquatica*, for which species it seems better to retain the old generic name. M. Bourlet also describes a number of new species, and concludes with some general remarks on the habits of the group, which he describes with considerable accuracy, though he is inclined to regard them as viviparous, which is a mistake.

His other two proposed genera, *Lepidocyrtus* and *Isotoma*, have been generally adopted.

The following is a list of his species :

Macrotoma plumbea	=	Tomocerus plumbeus.
„ nigra		„ nigra.
„ longicornis		„ longicornis.
„ ferruginosa		„ nigra.
Lepidocyrtus curvicollis		Lepidocyrtus curvicollis.
Heterotoma flavescens		Orchesella rufescens.
„ villosissima		„ villosa.
„ livida		?
„ crystallina		Templetonia crystallina.
„ grisea		Orchesella villosa.
„ pulchricornis		„ cincta.
„ musci		„ „
„ vaga		„ „
„ septempunctata		„ „
„ quadripunctata		„ „
„ cincta		„ „
Isotoma villosa		„ villosa.
„ viridis		Isotoma viridis.
„ cærulea		„ „
„ bifasciata		„ aquatilis.
„ trifasciata		„ „
„ arborea		„ arborea.
„ nivalis		Degeeria nivalis.
„ rubricauda		Isotoma arborea.
„ cursitans		Degeeria nivalis.
„ fœnestrarum		„ fenestrarum.
„ fusiformis		Degeeria nigromaculata.
„ violacea		Lepidocyrtus violaceus.
Hypogastrura aquatica		Podura aquatica.

I will now proceed, though somewhat out of chronological order, to M. Bourlet's second memoir, 'Sur les Podurelles.'[1] A great part of this memoir is merely a reprint of the preceding.

The species described are as follows:

		BOURLET, 'Mém. Soc. Roy. Douai.'
Macrotoma plumbea	=	Tomocerus plumbeus.
„ spiricornis		„ longicornis.
Lepidocyrtus curvicollis		Lepidocyrtus curvicollis.
„ argentatus		„ lignorum.
„ rivularis		„ æneus ?
Ætheocerus rufescens		Orchesella rufescens.
„ crystallinus		Templetonia crystallina.
„ griseus		Orchesella villosa (young).
„ pulchricornis		„ cincta.
„ cinctus		„ „
„ rubrofasciatus		„ rufescens.
„ quinquefasciatus		„ „
„ dimidiatus		„ „
„ aquaticus		Isotoma palustris.
Podura villosa		Orchesella villosa.
„ viridis		Isotoma viridis.
„ bifasciata		„ aquatilis.
„ trifasciata		„ „
„ arborea		„ arborea.
„ nivalis		Degeeria nivalis.
„ annulata		„ annulata.
„ palustris		Isotoma palustris.
„ cursitans		Degeeria nivalis.
„ argenteo-cincta		Seira platani.
„ violacea		Lepidocyrtus violaceus ?
Hypogastrura muscorum		Achorutes muscorum

PODURIDES.

- Couvertes d'écailles
  - Antennes longues, de trois articles, le dernier beaucoup plus long que les autres . 1er genre, *Macrotoma*.
  - Antennes courtes, de quatre articles . . . . . 2e genre, *Lepidocyrtus*.
- Sans écailles.
  - Un organe saltatoire .
    - Antennes de longueur moyenne, variant de deux à cinq articles inegaux . 3e genre, *Ætheocerus*.
    - Antennes courtes, constamment de quatre articles à peu près égaux . 4e genre, *Podura*.
    - Antennes très courtes, de quatre articles, organe saltatoire attaché sous le ventre, et non à son extrémité . 5e genre, *Hypogastrura*.
  - Point d'organe saltatoire . 6e genre, *Adicranus*.

Here he has substituted the term *Ætheocerus* for *Heterotoma*, repeating, without the least misgiving, his curious error about the antennæ; he abandons the term *Isotoma*, replacing it by the old generic name *Podura;* and he proposes a new generic term, *Adicranus*, which, however, is synonymous with Burmeister's *Lipura*.

The *Smynthuridæ* he divides into two genera, characterised as follows:

Smynthurus.—Antennæ four-jointed; no dorsal tubercles.

Dicyrtoma.—Antennæ eight-jointed; two dorsal tubercles.

Of the former, he describes six species, four being new; of the latter, two species, both new. I have sometimes been disposed to regard *Dicyrtoma* as synonymous with my genus *Papirius*. In this case, however, M. Bourlet is mistaken in regarding the antennæ as eight-jointed.

In both his memoirs M. Bourlet gives many details concerning the external organisation and habits of the *Collembola*, but it is much to be regretted that he was not more conversant with the literature of the subject.

Lucas[1] places the THYSANURA between the MYRIAPODA and the ANOPLURA, adopts Templeton's genera *Orchesella* and *Achorutes*, and describes the following species:—*Orch. filicornis*, Tem.; *O. cincta*, Tem.; *Or. succincta*, Guérin (which appears to consist of the very dark specimens); *Podura arborea*, L.; *viatica*, L.; *plumbea*, L.; *villosa*, L.; *annulata*, Fab.; *aquatica*, L.; *nivalis*, L.; *cincta*, L.; *lignorum*, Fab.; *pusilla*, L.; *vaga*, L.; *ambulans*, L.; *monura*, Schrank; *fimetaria*, L.; *nitida*, Tem.; *nigromaculata*, Tem.; *albocincta*, Tem.; *cingula*, Tem.; *fuliginosa*, Tem.; *fasciata*, Say; *bicolor*, Say; *iricolor*, Say; *Achorutes dubius*, Tem.; *muscorum*, Tem.; *maritimus*, Guér.; *Smynthurus signatus*, Fab.; *viridis*, Geof.; *polypodus*, L.; *ater*, L.; *fuscus*, Lacord. and Boisd.; *guttatus*, Say.

Of the *Lepismidæ* he recognises three genera, *Machilis* with three species, *Petrobius* with one (our *M. maritimus*), and *Lepisma* with eleven.

original observations, but is carefully executed, and fully answers to the title.

Mr. Templeton's memoir[1] on the genus *Cermatia*, and some other exotic *Annulosa*, contains a description of a new species of *Lepisma*, for which he proposes the name *L. niveofasciata;* some observations on Linnæus' *L. polypoda*, which he considers may perhaps prove to be the species now known as *Machilis maritimus;* and some remarks on the relations of *Lepisma* to *Podura*.

In the same year M. Nicolet published his 'Recherches pour servir à l'histoire des Podurelles,'[2] one of the most important contributions to our knowledge of the group which has yet appeared. In this excellent memoir M. Nicolet gives a full account of the external and internal anatomy of the group, and describes each species in detail. The plates, which are nine in number, are well executed, and many of the species are carefully coloured. Unfortunately MM. Nicolet and Bourlet were ignorant of one another's labours, and in many cases the same species is described by them both under different names. M. Nicolet gives (p. 6) the following table of the genera :—

[1] 'Trans. Ent. Soc. London,' 1842, p. 304.

[2] 'Nouveaux Mémoires de la Société Helvétique des Sciences Naturelles,' 1842.

s s i	Antennes de 4 articles, moins longues que la tête.	Point d'appendice saltatoire.	Point de mâchoires ; insectes suceurs.	4 yeux par groupe latéral.	*Les Achorutes.*
			Des mâchoires ; insectes broyeurs.	Yeux en nombre variable.	*Les Anurophores.*
		Un append. salt. très court, inséré sous l'antépénultième segment ventral.	Idem.	8 yeux par groupe latéral.	*Les Podures.*
s z s	Antennes de 4 articles, plus longues que la tête.	Append. placé sous le pénultième seg. à pièce inf. beaucoup plus courte que les filets.	Idem.	7 yeux par groupe latéral.	*Les Desories.*
			Idem.	8 yeux par groupe latéral.	*Les Cyphodéires.*
-	Antennes de 4 articles égaux, moins longes que le corps.	Append. à pièce inf. plus longue que les filets.	Idem.	7 yeux par groupe latéral.	*Les Tomocères.*
	Antennes de 4 articles inégaux, plus longues que le corps.	Appendice très long, triarticulé.	Idem.	8 yeux par groupe latéral.	*Les Degeeries.*
-	Antennes de 4 articles, plus longues que la tête et le corcelet pris ensemble.	Append. très long, à pièce inf. égale en longueur aux filets.	Idem.	6 yeux par groupe latéral.	*Les Orcheselles.*
i	Antennes coudées de 6 articles.	Idem.			
lées	... ...				*Les Smynthures.*

The arrangement which I have adopted is, in many respects, the same, but I have been compelled to alter the nomenclature considerably. The genus *Achorutes* of Templeton was founded for species in which the spring is present, though small, and must, of course, be retained for these, as M. Nicolet himself subsequently admitted. Nicolet's name *Anurophorus* must give way to Burmeister's *Lipura*, which has the precedence by several years. The name *Desoria* was anticipated by Bourlet's *Isotoma*, and *Cyphoderus* by *Lepidocyrtus*.

As we shall see in the anatomical part of this work, I differ from Nicolet greatly as to the internal organisation of these insects; but this is probably owing in some measure to our having examined different species. On the whole, his memoir seems to me a very admirable monograph.

His species are as follows:

Achorutes tuberculatus	=	Anoura muscorum.
Anurophorus fimetarius		Lipura fimetaria.
„ laricis		„ corticina.
Podura aquatica		Podura aquatica.
„ similata		Achorutes similatus.
„ cyanocephala		„ cyanocephalus.
„ cellaris		„ cellaris.
„ armata		„ armata.
„ rufescens		„ rufescens.
Desoria glacialis		Isotoma saltans.
„ virescens		„ viridis.
„ tigrina		„ tigrina.
„ fulvomaculata		„ fulvomaculata.
„ cinerea		„ cinerea.
„ cylindrica		„ arborea.
„ viatica		„ viatica.
„ pallida		„ arborea.
„ ebriosa		„ „
„ annulata		„ annulata.
„ riparia		„ aquatilis.
„ fusca		„ fusca.
Cyphodeirus capucinus		Lepidocyrtus curvicollis.
„ gibbulus		„ gibbulus.
„ lignorum		„ lignorum.
„ pusillus		„ pusillus.
„ æneus		„ æneus.
„ agilis		„ agilis.
„ parvulus		„ parvulus.
„ albinos		Beckia albinos.

Tomocerus plumbeus	=	Tomocerus longicornis.
„ celer		„ niger.
Degeeria nivalis		Degeeria nivalis.
„ disjuncta		„ disjuncta.
„ corticalis		„ corticalis.
„ platani		Seira platani.
„ pruni		„ pruni.
„ elongata		„ elongata.
„ erudita		„ erudita.
„ lanuginosa		Degeeria lanuginosa.
„ margaritacea		Templetonia crystallina.
„ muscorum		Degeeria muscorum.
„ domestica		Seira domestica.
Orchesella melanocephala		Orchesella rufescens.
„ villosa		„ villosa.
„ fastuosa		„ cincta.
„ unifasciata		„ „
„ sylvatica		„ „
„ bifasciata		„ „
Smynthurus signatus		Smynthurus fuscus.
„ oblongus		„ oblongus.
„ viridis		„ viridis.
„ fuscus		Papirius fuscus.
„ ornatus		„ ornatus.
„ Coulonii		„ „

Bourlet's Memoirs on the Poduridæ and Smynthuridæ in the 'Ann. de la Soc. Ent. de France' for 1841 and 1842, contain merely short abstracts from his other works.

In 1842 Mr. Westwood described and figured[1] the very interesting genus *Campodea*, which he correctly described as "more nearly allied to *Lepisma* and *Ma-*

[redacted]

The volume containing the PODURÆ was written by M. Gervais, who placed them after the *Aphaniptera* (*Pulex*). He gives a careful *résumé* of the works of previous authors, and treats the modern genera as subgenera, retaining the term *Podura* for the group. He adopts Bourlet's genus *Heterotoma*, and describes all Nicolet's species as well as Bourlet's, so that many appear twice over.

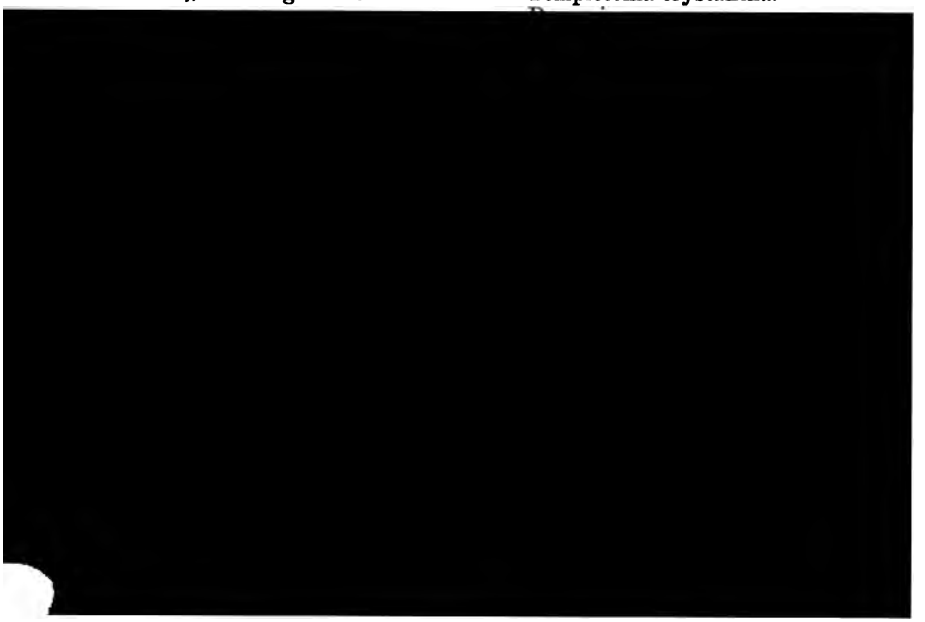
Nevertheless, in this work[1] M. Gervais has given us an excellent summary of preceding memoirs on the group, and has proposed some additional species, which, however, are unfortunately described with much brevity.

The following is the list of species as given by him:

Smynthurus signatus	=	Smynthurus fuscus.
„ oblongus		„ oblongus.
„ viridis		„ viridis.
„ fuscus		Papirius fuscus.
„ ornatus		„ ornatus.
„ Couloni		„ „
„ Bourleti		„ Bourletii.
„ ater		„ fuscus.
„ bilineatus		„ oblongus.
„ aquaticus		„ aquaticus.
„ lupulinæ		„ lupulinæ.
„ pallipes		„ pallipes.
„ polypodus		Papirius polypodus.
„ guttatus		Smynthurus guttatus.
Dicyrtoma atropurpurea		Dicyrtoma atropurpurea.
„ dorsimaculata		„ dorsimaculata.
Macrotoma plumbea		Tomocerus plumbeus.
„ celer		„ niger.
„ nigra		„ „
„ longicornis		„ longicornis.
„ ferruginosa		„ niger.
„ lepida		„ „
Lepidocyrtus curvicollis		Lepidocyrtus curvicollis.
„ capucinus		„ „
„ gibbulus		„ gibbulus.
„ lignorum		„ lignorum.
„ pusillus		„ pusillus.
„ æneus		„ æneus.

[1] 'His. des Ins. Aptères,' v. iii.

Lepidocyrtus agilis	= Lepidocyrtus agilis.
„ parvulus	„ parvulus.
„ albinos	Beckia albinos.
Orchesella filicornis	Orchesella cincta.
„ cincta	„ „
„ melanocephala	„ rufescens.
„ villosa	„ villosa.
„ fastuosa	„ cincta.
„ unifasciata	„ „
„ sylvatica	„ „
„ bifasciata	„ „
„ succincta	„ „
„ histrio	„ villosa.
Heterotoma flavescens	„ rufescens.
„ villossissima	„ villosa.
„ livida	?
„ crystallina	Templetonia crystallina.
„ grisea	Orchesella villosa.
„ pulchricornis	„ cincta.
„ musci	„ „
„ vaga	„ „
„ septemguttata	„ „
„ quadripunctata	„ „
„ cincta	„ „
„ chlorata	Isotoma viridis.
Degeeria nivalis	Degeeria nivalis.
„ variegata	„ variegata.
„ disjuncta	„ disjuncta.
„ corticalis	„ corticalis.
„ platani	Seira platani.
„ pruni	„ pruni.
„ elongata	„ elongata.
„ erudita	„ erudita.
„ lanuginosa	Degeeria lanuginosa.
„ margaritacea	Templetonia crystallina.



Isotoma cursitans	=	Degeeria nivalis.
,, fenestrarum		,, fenestrarum.
,, fusiformis		,, nigromaculata.
,, violacea		Lepidocyrtus violaceus.
,, pulex		,, gibbulus.
,, spilosoma		Isotoma spilosoma.
,, Desmarestii		,, viridis.
Achorutes aquaticus		Podura aquatica.
,, armatus		Achorutes armatus.
,, rufescens		,, rufescens.
,, muscorum		Anoura muscorum.
,, similatus		Achorutes similatus.
,, cyanocephalus		,, cyanocephalus.
,, cellaris		,, cellaris.
,, bielanensis		,, bielanensis.
,, murorum		,, murorum.
,, agaricorum		,, cyanocephalus.
,, maritimus		Lipura maritima.
,, larvatus		Achorutes rufescens.
Lipura ambulans		Lipura ambulans.
,, laricis		,, corticina.
,, corticina		,, ,,
Anoura tuberculata		Anoura muscorum.
,, rosea		,, rosea.

In order to extricate the group from the state of confusion into which it had fallen, M. Nicolet published in 1846 a second memoir in the 'Ann. de la Soc. Ent. de France.' He there divides the PODURIDÆ into three subfamilies—"Smynthurelles," "Podurelles," and "Lipurelles;" the first being short, and the two latter elongated, while the last differs from the two first in being non-saltatorial. He recognises the following genera, viz. *Smynthurus*, *Dicyrtoma*, *Orchesella*, *Degeeria*, *Isotoma*, *Podura*, *Achorutes*, *Tomocerus*, *Cyphoderus*, *Anurophorus*, and *Anoura*. He also takes great pains to remove the confusion produced by the simultaneous investigations of the later, and the insufficient descriptions of earlier, authors.

He recapitulates the number of species as follows:

Machilis . . . 16		
Lepisma . . . 25	LEPISMIDES . .	45
Nicoletia . . . 2		
Campodea . . 2		

Smynthurus	19		
Dicyrtoma	7		
Orchesella	20		
Degeeria	21		
Isotoma	22		
Podura	1	Podurides	131
Achorutes	12		
Tomocerus	3		
Cyphoderus	13		
Anurophorus	5		
Anoura	8		
	176		

I think, however, that the consolidation of species might with advantage have been carried even further.

He also presents the following table of the genera:

		Genres.
1.	Des filets sétiformes à l'extrémité postérieure de l'abdomen. *Les Lépismides* . . 2	
	Point de filets sétiformes, mais souvent une queue fourchue repliée sous le ventre et servant au saut. *Les Podurides* . . 5	
2.	Corps pourvu d'écailles 3	
	Corps dépourvu d'écailles 4	
3.	Filets terminaux inégaux, corps subcylindrique	*Machilis.*
	Filets terminaux égaux, corps déprimé . .	*Lepisma.*
4.	Trois filets terminaux	*Nicoletia.*

[redacted]

		Genres.
8.	Corps composé de neuf segments apparents . 9	
	Corps composé de huit segments apparents . 10	
9.	Appendice saltatoire très court, à filets larges et légèrement arqués, sommet articulé .	*Achorutes.*
	Appendice saltatoire un peu allongé à filets étroits cylindriques, fortement arqués et biarticulés	*Podura.*
10.	Tête directe, ou insérée à l'extrémité antérieure du thorax 11	
	Tête inclinée ou insérée en dessous de l'extrémité antérieure du thorax . . . 13	
11.	Antennes de quatre articles 12	
	Antennes coudées de six articles . . .	*Orchesella.*
12.	Appendice saltatoire à base plus courte que les filets	*Isotoma.*
	Appendice saltatoire à base égale en longueur aux filets	*Degeeria.*
13.	Appendice saltatoire biarticulé à base plus longue que les filets	*Cyphoderus.*
	Appendice saltatoire très long et triarticulé .	*Tomocerus.*
14.	Des mâchoires, corps non tuberculé, peu ou point velu, yeux variant en nombre dans chaque espèce	*Anurophorus.*
	Pas de mâchoires, un siphon, corps tuberculé, non écailleux peu velu, quatre yeux par groupe latéral	*Anoura.*

In 1849 M. Lucas published his 'Exploration Scientifique de l'Algerie.' He described six species of Collembola, all of which he regarded as new, although three at least seem to be identical with European forms.

M. G. Frauenfeld[1] in 1854 proposed a new genus, *Tritomurus*, for a blind species found in the cave of Treffen. It is most nearly allied to *Tomocerus*, but, in addition to the absence of eyes, differs in the constitution of the spring, which possesses an additional segment.

M. Kolenati[2] has described a second series of *Tritomurus*, under the name of *Tritomurus macrocephalus*.

[1] 'Verh. d. Zool. Bot. Vereins in Wien,' 1854.
[2] 'Sitz. des k. Ak. d. Wiss. Wien,' 1858.

This species, however, differs greatly from the generic description given by Frauenfeld, particularly in the appendages of the head, the true nature of which I cannot understand.

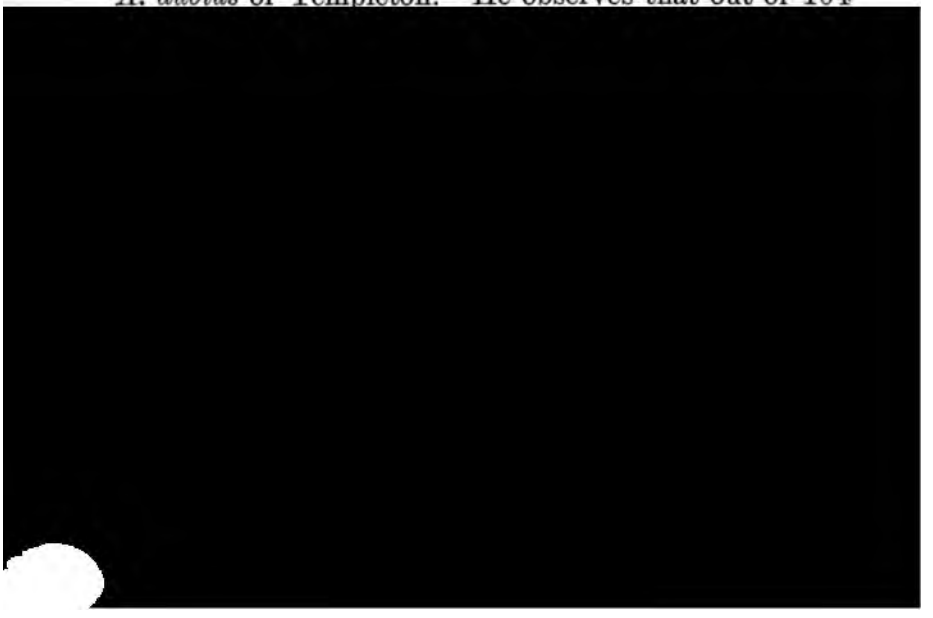
In 1854 M. H. L. Elditt[1] published an "Einleitung zur Monographie der Thysanuren,' being an analysis of the memoirs by Nicolet and Bourlet.

In the following year M. Brauer[2] mentions the presence on snow of a *Podura* which he refers to the *Isotoma saltans* of Agassiz.

I have been unable to see M. Papon's note, "Ueber eine im Februar, 1855, bei Chur beobachtete Desoria."[3]

In 1858 M. J. A. Herklots[4] proposed the name of *Degeeria pi* for the *Podura arborea grisea* of De Geer, which, he observes, is quite distinct from the *D. nivalis*. His observations on the subject seem to me perfectly correct, but both his name and also that of *P. nigromaculata*, proposed for the same species by Templeton, must give way to the far earlier one of *D. annulata*.

In the same year M. Low[5] published a note on a *Podura* found in considerable numbers on the surface of snow. He refers it to the *Achorutes murorum* of Gervais, which I consider to be identical with the *A. dubius* of Templeton. He observes that out of 104



until the year 1863; while, as regards England, I have only met with the casual mention of two species, *Podura plumbea* and *Smynthurus fuscus*, in Samouelle's 'Entomologist's Useful Compendium.'

In the above-mentioned year I published my first memoir on the COLLEMBOLA, which was followed by a second in the year following, a third in 1867, and a fourth in 1869. In these memoirs I have recorded about sixty English species, and have given some account of their habits and anatomy. As regards the latter, I differed in many important points from Nicolet, to whom we were indebted for the first account of their internal organisation. For instance, as regards the digestive organs, I found myself compelled to question the presence of Malpighian vessels. Again, with the exception of *Smynthurus*, I found to my surprise that the COLLEMBOLA had no tracheæ, while Nicolet figured a complete system of them in *Podura*, and apparently considered that a similar arrangement prevailed throughout the group.

These questions, however, are more fully considered in the chapter devoted to anatomy.

M. de Olfers, in his 'Annotationes ad anatomiam Podurarum, Dissertatio inauguralis,' adopted, for the most part, the views of Nicolet. He was not, however, acquainted with my memoirs.

In 1865 Dr. F. Meinert,[1] of Copenhagen, published an excellent memoir on the *Campodeæ*, which has been translated in the 'Annals and Magazine of Natural History' for November, 1867.

Dr. Meinert incidentally mentions that he agrees with me as to the respiratory organs of the COLLEMBOLA, but the principal part of the paper is devoted to the consideration of the mouth parts. He points out that the mouth of the COLLEMBOLA differs from both of the principal types found amongst insects. The mandibles and maxillæ do not articulate with the skull by means of a hinge-joint, as in all other mandibulate insects,

[1] "Naturhis. Tids.," 1865. 'Ann. Mag. of Nat. His.,' 1867.

but "are retracted within the cavity of the skull, so that only their apices are visible outside the mouth; but nevertheless they are calculated for biting, capable of being moved laterally against each other," and differ, therefore, essentially from those of the suctorial groups. "This intermediate type is amongst insects only found in the THYSANURA, and affords one of the two principal characters of this order or suborder, the other being this, that they remain in the larval stage without undergoing any metamorphosis at all." He excludes the *Lepismidæ*, therefore, from the THYSANURA, although the articulation of the mandibles approximates to that of *Podura*.

Lastly, in 1869, M. Tullberg published a valuable monograph of the *Lipuridæ*, in which family he includes *Achorutes*. For reasons which will be given presently, I am unable to agree with him in this.

Having thus very briefly referred to the principal memoirs which have appeared on the *Thysanura* and *Collembola*, I will now proceed to consider the arrangement and position of these two groups.

CHAPTER I.

ON THE CLASSIFICATION OF THE COLLEMBOLA AND THYSANURA.

Linnæus placed his genera *Lepisma* and *Podura* immediately after the Diptera, and at the head of the Aptera, followed by *Termes*, *Pediculus*, *Pulex*, *Acarus*, *Phalangium*, *Aranea*, *Scorpio*, *Cancer*, *Monoculus*, *Oniscus*, *Scolopendra*, and *Julus*, in the above order.

The system adopted by Geoffroy was very similar. He classed *Podura* and *Lepisma*, however, between *Pediculus* and *Acarus*.

Fabricius, on the contrary, on account of the structure of their mouths, united them with the Neuroptera, in his order *Synistata;* and in this view he was followed by Blainville.

The order Thysanura was established in 1796 by Latreille, who placed it between *Pulex* and the Parasita. In the 'Considérations Générales' (1810), he arranged it with the Myriapoda and Parasita among the Arachnida. In 1829, however, he regarded it as the second order of Insects, placing it between the Myriapoda and the Parasita.

Lamarck, in his 'Animaux sans Vertèbres,' adopted the group Thysanura, which he united with the Myriapods to form his *Arachnides Crustacéennes*, constituting the first section of his *Arachnides antennées-trachéales*. He even regarded the Thysanura as more nearly allied to the Crustacea than to the Insecta; they are, he said, "assurément point des Crustacés et encore moins des Insectes." In separating them thus widely from the

other Hexapods, he seems to have been mainly influenced by the absence of metamorphoses.

Cuvier, on the contrary, regarded them as true insects, and arranged them as the second order, preceded by MYRIAPODA, and followed by the PARASITA.

Von Siebold does not adopt the order THYSANURA, but considers that the two families of *Lepismidæ* and *Poduridæ*, together with the *Pediculidæ* and *Nirmidæ*, form the order APTERA, which he regards as the first among the true Insects, the MYRIAPODA forming, in his system, part of the CRUSTACEA.

Burmeister, in his 'Handbuch der Entomologie,' treated the THYSANURA as a separate tribus, which he placed between the Mallophaga and Orthoptera.

According to Bourlet, the THYSANURA follow the Myriapods, and constitute the first order of insects. Macleay classed them with the Myriapods, and Lice among his Ametabola.

Lucas adopted Laporte's name of "Monomorphes" for the THYSANURA, and placed them between the Myriapods and the *Anoplura*.

M. Gervais, in the 'Histoire Naturelle des Insectes Aptères,' points out the great diversity which exists between the *Lepismidæ* and the *Poduridæ*. Referring to the classification of Fabricius and Blainville, who

saute avec sa queue, puisque c'est là un de leurs caractères les plus généraux."

Gerstäcker, in the 'Handbuch der Zoologie,' places the COLLEMBOLA amongst the Orthoptera, on account of the absence of metamorphoses, and the mandibulated mouth.

Latreille, in his "Essay on the THYSANURA" in the 'Annales du Musèum,' vol. i, p. 161, says—"Par la masse de leurs caractères, les Thysanoures appartiennent à la classe des Insectes. La composition du thorax, des organes de la locomotion, et de la bouche, l'indiquent suffisamment. A l'égard même de ces dernières parties; et surtout de l'oviducte extérieur du plus grand nombre de femelles, les Thysanoures ont la plus grande affinité avec divers Orthoptères. Mais sous d'autres considérations, comme l'absence de métamorphoses, les organes de la vision, les appendices abdominaux et les habitudes, ils se rapprochent aussi des Myriapodes et des Arachnides. D'après un tel mélange de rapports, il est naturel de conclure que ces animaux font la transition des Myriapodes aux Insectes, et que vu leur plus grande ressemblance avec ceux-ci, ils doivent être placés à leur tête. Point de transformations, abdomen terminé par des soies, tel est, suivant le docteur Leach, le caractère essentiel de l'ordre des Thysanoures; mais il nous semble, par son extrême concision un peu trop vague; et aussi d'écarter tout embarras, nous le signalerons ainsi; point de métamorphoses, ni de stigmates apparents; corps généralement recouvert de petites écailles, avec l'abdomen terminé par trois filets ou par une queue fourchue servant à sauter."

These do not, however, appear to me to be the real characteristics of the group. The absence of metamorphoses must be taken for what it is worth. Spiracles are present in the *Lepismidæ* and in *Smynthurus*, but are wanting in the majority, if not the whole, of the *Papiriidæ*, *Poduridæ*, and *Lipuridæ*. Scales do not occur either in the *Smynthuridæ*, *Papiriidæ*, or *Lipuridæ*,

and are wanting in several genera of *Poduridæ*. Lastly, the saltatorial appendage is absent in the *Lipuridæ*, and though present in all the *Smynthuridæ*, *Papiriidæ*, and *Poduridæ*, we must remember that the saltatorial appendage of *Podura* and *Achorutes* is not, in fact, homologous with that of the other genera, an important point, the significance of which has been overlooked by previous authors.

Again, the mouth-parts of the *Lepismidæ* and *Poduridæ* are constructed on a totally different plan.

Dana[1] regards the THYSANURA and COLLEMBOLA as true insects, but as forming one of three great groups into which that class may be divided, namely—

Ptero-prosthenics, or Chenopters, including the Hymenoptera, Diptera, Aphaniptera, Lepidoptera, Homoptera, Trichoptera, and Neuroptera;

Ptero-metasthenics, or Elytropters, comprising the Coleoptera, Hemiptera, and Orthoptera; and thirdly,

The Thysanura.

It appears to me that the two former groups are more nearly allied to one another than they are to the third; or, at least, to that portion of the third group for which I have proposed the name "COLLEMBOLA."

[redacted]

The points which we have principally to consider in relation to the classification and position of the THYSANURA and COLLEMBOLA are—the absence of metamorphoses; the absence of wings; the presence or absence of tracheæ; the structure of the mouth; the saltatory appendage; and the ventral tube.

The last-mentioned organ, though observed by most of the preceding writers, has not, I think, attracted the attention it deserves. It is, in fact, the true characteristic of the group. The absence of wings and of metamorphoses is not peculiar to the COLLEMBOLA; in fact the presence of metamorphoses is closely connected with that of wings. To the tracheæ we must not attach too much importance; for though absent in the great majority of the group, they occur in *Smynthurus*. The peculiar mouth-parts of the mandibulate genera are entirely absent in *Anura;* and the caudal appendage is wanting in the *Lipuridæ*.

Thus, then, the ventral tube is characteristic as being general to the species belonging to the Linnæan genus *Podura*, and still more so, as being peculiar to them; at least, I know of no similar organ in any other group of Articulata. The presence of tracheæ, the structure of the mouth, and the saltatory appendage, all indicate a wide distinction between the *Lepismidæ* and the *Poduræ*, and, when considered in conjunction with the fact that the ventral tube is absent among the former, force us to the conclusion that the two groups are much less closely allied than has hitherto been supposed.

This was, indeed, fully recognised by M. Gervais,[1] whose remarks on the subject I have already quoted (antè, p. 32). Mr. Templeton has also expressed the same opinion. He observes that[2] "the *Lepismidæ* should be separated most markedly from the other division of the THYSANURA with which they are usually associated; the antennæ, caudal apparatus, and more especially the

[1] 'Loc. cit., vol. iii, p. 378.
[2] 'Trans. Ent. Soc. London,' 1842, p. 305.

mouth (and the habits of the animals), having nothing in common."

We must, indeed, in my opinion, separate them entirely from one another; and I have proposed for the group comprised in the old genus *Podura* the term COLLEMBOLA, as indicating the existence of a projection or mammilla enabling the creature to attach or glue itself to the body on which it stands.

We now come to consider whether this group should be classed among the Insecta, or whether Lamarck was right in separating it from that great class. Taking each of the characteristic points separately, we begin with the absence of metamorphoses. To this we must not attribute too much importance. There are species of Orthoptera and of Neuroptera which are almost in a similar position. So, again, as regards the absence of wings, the same argument holds good: in all orders of insects there are wingless species. Moreover, although it may seem paradoxical to say so, the character of an organ is of greater classificatory value than the absence of it. Thus, for instance, we have cattle and deer without horns, but no cows have deer's horns or *vice versâ*. So the presence of four wings is absolutely peculiar to the Insecta; but some insects have only

to one of the most important parts of their internal anatomy.

The structure of the mouth, as far as it goes, is unfavorable to the view of those who regard the COLLEMBOLA as true insects. I quite agree with Dr. Meinert that the mouth differs essentially from both the principal types found among insects, without, however, making any near approach to that of the Myriapoda or the Arachnida.[1]

The presence of a saltatory caudal appendage must be taken into consideration. It is very remarkable that no similar apparatus is possessed by any one of the almost innumerable insects, many of which, however, possess the power of leaping in a high degree. Nor, on the other hand, do any of the COLLEMBOLA jump like *Gryllus*, *Haltica*, or *Pulex*, by means of their hind legs. The true value of such a character as this, however, is as difficult to estimate as it is easy to apply.

The same observations apply to the ventral tube, which, as I have already observed, is even more characteristic of the COLLEMBOLA than the caudal appendage.

As the upshot of all this, then, while the COLLEMBOLA are clearly more nearly allied to the Insecta than to the Crustacea or Arachnida, we cannot, I think, regard them as Orthoptera or Neuroptera, or even, in the strictest sense, as true insects. That is to say, the Coleoptera, Orthoptera, Neuroptera, Lepidoptera, &c., are, in my opinion, more nearly allied to one another than they are to the *Poduridæ* or *Smynthuridæ*. On the other hand, we certainly cannot regard the COLLEMBOLA as a group equivalent in value to the Insecta. If, then, we attempt to map out the Articulata, we must, I

[1] I say any "near" approach, because, as Mr. Humbert has pointed out to me, the mouth-parts of *Scolopendrella* in some points approach those of the COLLEMBOLA. This genus, indeed, appears to be more interesting and peculiar than either Gervais or Newport supposed. For instance, it has on the underside of each segment a pair of appendages closely resembling those of the *Lepismidæ*—a fact which suggests doubts whether the subabdominal appendages of that group really represent the legs of Myriapoda.

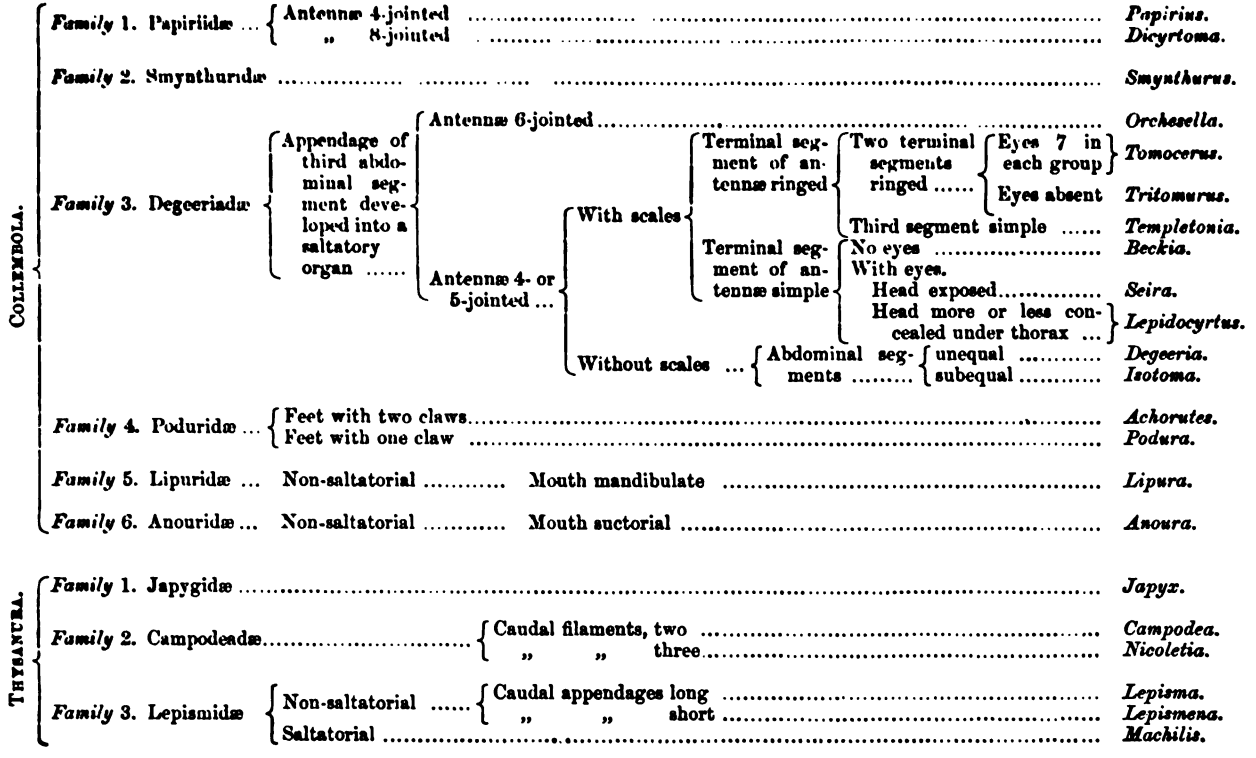
think, regard the Crustacea and Insecta as continents, importance, but and COLLEMBOLA as islands—of less the Myriapoda still detached.

Or if we represent the divisions of the Articulata like the branching of a tree, we must picture the COLLEMBOLA and THYSANURA as separate branches, though small ones, and much more closely connected with the Insecta than with the Crustacea or the Arachnida.

From the point of view which we occupy the extremities alone of such branches are visible, and, considering the delicacy of the COLLEMBOLA, and the consequent improbability that we shall ever acquire any satisfactory knowledge of the extinct forms, it is not likely that the connecting stems will ever be fully known to us.

The classification of the COLLEMBOLA adopted in the present work is shown in the following table.

As a matter of convenience, no doubt, several of the proposed families might be consolidated. The characters, however, by which they differ from one another are of considerable importance, and the great object in all classification should be to attain to the most natural system. Moreover, as far as the paucity of species is concerned, we must remember that the number will doubtless ere long be considerably increased.


COLLEMBOLA.
Family 1. Papiriidæ ... Antennæ 4-jointed ... Papirius.
„ 8-jointed ... Dicyrtoma.
Family 2. Smynthuridæ ... Smynthurus.
Family 3. Degeeriadæ
Appendage of third abdominal segment developed into a saltatory organ ...
Antennæ 6-jointed ... Orchesella.
Antennæ 4- or 5-jointed ...
With scales
Terminal segment of antennæ ringed
Two terminal segments ringed ...
Eyes 7 in each group ... Tomocerus.
Eyes absent ... Tritomurus.
Third segment simple ... Templetonia.
Terminal segment of antennæ simple
No eyes ... Beckia.
With eyes.
Head exposed ... Seira.
Head more or less concealed under thorax ... Lepidocyrtus.
Without scales ...
Abdominal segments ...
unequal ... Degeeria.
subequal ... Isotoma.
Family 4. Poduridæ ... Feet with two claws ... Achorutes.
Feet with one claw ... Podura.
Family 5. Lipuridæ ... Non-saltatorial ... Mouth mandibulate ... Lipura.
Family 6. Anouridæ ... Non-saltatorial ... Mouth suctorial ... Anoura.
THYSANURA.
Family 1. Japygidæ ... Japyx.
Family 2. Campodeadæ ...
Caudal filaments, two ... Campodea.
„ „ three ... Nicoletia.
Family 3. Lepismidæ
Non-saltatorial ...
Caudal appendages long ... Lepisma.
„ „ short ... Lepismena.
Saltatorial ... Machilis.

CHAPTER III.

ON THE IMPORTANCE OF THE COLLEMBOLA AND THYSANURA IN RELATION TO THE EVOLUTION OF THE INSECTA.

THE THYSANURA and COLLEMBOLA possess a peculiar interest from the position which they appear to occupy in the evolution of insects.

It has always seemed to me that the metamorphoses of insects are among the principal difficulties of the Darwinian theory. Take, for instance, the life-history of a butterfly. It commences as a caterpillar, with powerful jaws adapted for cutting and masticating leaves, then passes through a period of fasting, and in its perfect condition has a very complex suctorial mouth. I omit for the present the consideration of the development of wings and the changes in the internal organs. Now, how can such a case have arisen ?

Fritz Müller is of opinion[1] "that the most ancient insects approached more nearly to the existing Orthoptera, and, perhaps, to the wingless *Blattidæ*, than to any other order, and that the complete metamorphosis of the Beetles, Lepidoptera, &c., is of later origin." There were, he adds, "perfect insects before larvæ and pupæ."

The following passage gives his views so clearly, and is so interesting, that I need no apology for quoting it entire:

"The order Orthoptera, including the Pseudo-neuroptera (*Ephemera*, *Libellula*, &c.), appears to approach nearest to the primitive form of insects. In favour of this view we have—

"1. The structure of their buccal organs, especially the formation of the labium, 'which retains, either perfectly or approximately, the original form of a second pair of maxillæ' (Gerstäcker).

"2. The segmentation of the abdomen. . . . .

"3. That, as in the Crustacea, the sexual orifice and anus are placed upon different segments; 'whilst the former is situate in the ninth segment, the latter occurs in the eleventh' (Gerstäcker).

"4. Their palæontological occurrence; in a fossil state the Orthoptera make their appearance the earliest of all insects, namely, as early as the Carboniferous formation, in which they exceed all others in number (Gerstäcker).

"5. The absence of uniformity of habit at the present day in an order so small when compared with the Coleoptera, Hymenoptera, &c. For this also is usually a phenomenon characteristic of very ancient groups of forms which have already overstepped the climax of their development, and is explicable by extinction in mass. . . . .

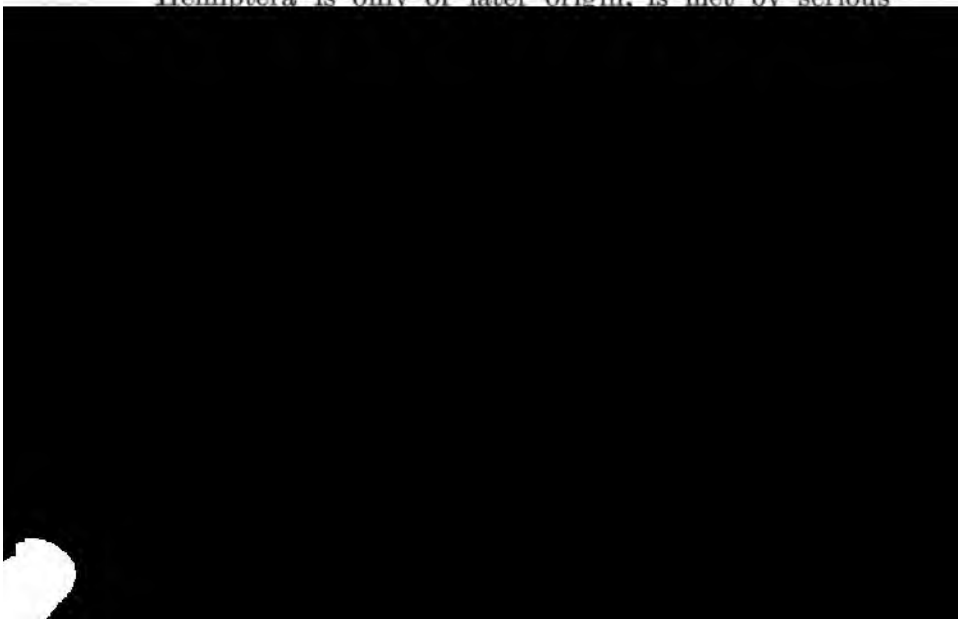
"If from all this it seems right to regard the Orthoptera as the order of insects approaching most nearly

[1] 'Facts for Darwin,' p. 118.

to the common primitive form, we must also expect that their mode of development will agree better with that of the primitive form than, for example, that of the Lepidoptera, in the same way that some of the prawns (*Penëus*), approaching most closely the primitive form of the Decapoda, have most truly preserved their original mode of development. Now, the majority of the Orthoptera quit the egg in a form which is distinguished from that of the adult insect almost solely by the want of wings; these larvæ then soon acquire rudiments of wings, which appear more strongly developed after every moult. Even this perfectly gradual transition from the youngest larva to the sexually mature insect preserves in a far higher degree the picture of an original mode of development, than does the so-called complete metamorphosis of the Coleoptera, Lepidoptera, or Diptera, with its abruptly separated larva-, pupa-, and imago-states.

"The most ancient insects would probably have most resembled these wingless larvæ of the existing Orthoptera. . . . .

"The contrary supposition, that the oldest insects possessed a 'complete metamorphosis,' and that the 'incomplete metamorphosis' of the Orthoptera and Hemiptera is only of later origin, is met by serious



tant resemblance to the quiescent pupæ of these animals."[1]

I quite agree with Müller that the "complete metamorphosis" of such insects as the Lepidoptera is probably of more recent origin than the so-called "incomplete metamorphosis" of the Orthoptera and Hemiptera.

Haeckel,[2] like Müller, attaches much importance to the geological evidence as regards the sequence in time of the different groups of Insecta; too much, perhaps, if we consider the great imperfection of the record, and the small number of fossil insects yet discovered. For a long time, he says, insects were represented only by the four mandibulate orders—the Archiptera, Neuroptera, Orthoptera, and Coleoptera—of which the first is probably the common stock (Stammform) of the three others. Subsequently the three diverging series of suctorial insects — the licking, piercing, and sucking—the Hymenoptera, Hemiptera, Diptera, and Lepidoptera, developed themselves from the mandibulate series. He differs from Müller somewhat, however, in regarding, not the true Orthoptera, but the Pseudo-neuroptera, as most nearly retaining the type of the original insect stock.

I confess that I feel great difficulty in understanding by what natural process a suctorial mouth like that of a gnat or butterfly could be developed from a powerfully mandibulate type like that of the Orthoptera or Coleoptera. At first the change would be a decided disadvantage; during the period of necessary quiescence the animal would be unable either to feed or to defend itself. The extreme shortness of the life of many insects in the perfect state seems also to present an additional difficulty.

The clue to the solution of this difficulty may, I think, be found in the recognition of that distinction between developmental and adaptive changes, to

[1] Müller, loc. cit., p. 118.
[2] 'Natürliche Schöpfungsgeschichte.'

which I called attention in my memoir "On the development of *Chloëon*."[1]

When an animal quits the egg in a form unlike that which it will present in its mature condition, the changes through which it passes in order to attain to that final and mature state, are changes of simple development. But, if during this period the creature is leading a separate and independent life, it is evident that it will be acted on also by external forces, and will be liable, therefore, to gradual modification through the action of natural selection; such modifications having reference to its then mode of life, and not to its ultimate condition. These are obviously of an origin distinct from the developmental changes; they explain many problems in natural history, which we cannot otherwise understand, and I have proposed for them the term "adaptational" or "adaptive."

The larvæ of insects are by no means mere stages in the development of the perfect animal. On the contrary, they undergo various changes and developments which have reference entirely to their own requirements and condition. That this is so must, indeed, be admitted by every believer in evolution. External circumstances act on the animal throughout its independent life, and consequently on larvæ as well as

strength or from any change of season, alters, however slightly, its habits or food, immediately it becomes subject to the action of distinct forces; natural selection affects it in two different, and it may be very distinct, manners, gradually leading to differences which may become so great as to involve an intermediate period of change and quiescence.

M. Brauer[1] believes that among existing types, the genus *Campodea* most nearly represents the original insect stock, and, like Müller, he considers that there were perfect insects before there were larvæ or pupæ.

He quotes the cases of *Melöe* and *Sitaris* as proofs that the sluggish, grub- or caterpillar-type of larva is to be regarded, not as a developmental form, but as an adaptational modification of the earlier, active hexapod form. As is well known, the larvæ of the beetles belonging to these genera quit the egg as active, hexapod little creatures, and subsequently turn into fat, sluggish larvæ, living in the cells of bees, and feeding on the honey intended by the bee for her own young.[2] These cases, however, must, I think, be ranked rather among the number of those in which the development is, to use M. Brauer's own expression, "falsified by the struggle for existence" (gefälscht durch den Kampf um's Dasein), and which, therefore, do not truly indicate the successive stages of evolution.

Mr. Darwin,[3] in the fourth edition of the 'Origin of Species,' has also some interesting remarks on the same subject:

"Fritz Müller, who has recently discussed this whole subject with much ability, goes so far as to believe that the progenitor of all insects probably resembled an adult insect, and that the caterpillar or

[1] "Betrachtungen über die Verwandlung der Insecten." 'Wien. Zool. Bot. Gesell.,' 1869.

[2] 'Newport Linn. Trans.,' 1851. Fabre, 'Ann. des Sci. Nat.,' sér. 4, vol. vii. See also 'Natural History Review,' 1863, p. 121.

[3] 'Origin of Species,' 4th edit., p. 530.

maggot, and cocoon or pupal stages, have subsequently been acquired; but from this view many naturalists, for instance Sir John Lubbock, who has likewise recently discussed this subject, would, it is probable, dissent. That certain unusual stages in the metamorphoses of insects have arisen from adaptations to peculiar habits of life can hardly be doubted; thus, the first larval form of a certain beetle, the *Sitaris*, as described by M. Fabre, is a minute, active insect, furnished with six legs, two long antennæ, and four eyes.

* * * *

It then undergoes a complete change; its eyes disappear, its legs and antennæ become rudimentary, and it feeds on honey; so that it now more closely resembles the ordinary larvæ of insects; ultimately it undergoes further transformations, and finally emerges as a perfect beetle. Now, if an insect, undergoing transformations like those of the *Sitaris*, had been the progenitor of the whole great class of insects, the general course of development, and especially that of the first larval stage, would probably have been widely different from what is actually the case; and it should be especially noted that the first larval stage would not have represented the adult condition of any insect."

dragon-fly. Indeed, the larva of one group may closely resemble the perfect condition of another. Thus, any one who will compare my drawing of the youngest larva of *Chloeon*[1] with that of *Campodea* (Pl. 50) must acknowledge the remarkable similarity which exists between them.

When Fritz Müller observes that "there were perfect insects before there were larvæ," it is probable that he excludes from the term "larvæ" the young of Orthoptera, to which, however, most English naturalists would unhesitatingly apply it. I presume, therefore, that he confines it to "maggots" and "grubs," perhaps including caterpillars. Brauer draws a broad distinction between the caterpillar form and the *Campodea* form of larva, classifying the former with the grub and maggot types. As, however, I have already pointed out,[2] the caterpillars of Lepidoptera agree more closely with the young of Orthoptera than with those of Diptera.

It is important to bear this in mind, because, in reference to the passage just quoted from 'The Origin of Species,' much turns on the meaning attached to the word "larva," and the difference there pointed out between the views of different entomologists is partly apparent only, being to a considerable extent due to the different senses in which the word larva is used.

M. Brauer, in the very interesting memoir to which I have already referred, gives it as his opinion that all existing insects are descended from a common stock resembling the genus *Campodea*, and in this I am very much disposed to agree with him. The *Campodea*-form occurs, indeed, among the Neuroptera, Orthoptera, Strepsiptera, and Coleoptera; nay, if we include caterpillars, which, as already mentioned, principally differ in possessing a heavier body, and consequently less agility, then also among the Hymenoptera and Lepidoptera.

[1] Ibid., Pl. 17, fig. 1.
[2] 'Linn. Trans.,' 1863, p. 65.

It must, however, be confessed that, although these various forms, which in their adult condition are so dissimilar, in an early stage resemble one another very closely in the well-developed head, the three thoracic segments each with a pair of legs, the segmented abdomen, the caudal appendages, &c., still in the construction of the mouth there are differences of great importance. Yet from another point of view the structure of the mouth seems to me to offer a very strong support to M. Brauer's opinion, and one of which I wonder that he has not availed himself.

On this point the remarks of Meinert are very important. Admitting the "great importance of the organs of the mouth for the establishment of the principal as well as subordinate divisions of insects,"[1] he says, "the essential point of difference is, in my opinion, to be found in the position of the first two pairs of appendages of the mouth with reference to the skull. One of these two principal types is characterised by the *mandibles articulating with the skull* by means of a hinge-joint, while the maxillæ are connected with the skull through a less perfect articulation, sometimes merely sliding on its anterior margin, which surrounds the mouth. This arrangement leaves the organs of the mouth entirely free outside the mouth; they can be

In those insects, on the other hand, which belong to the second type, the mandibles and maxillæ are not articulated with the skull or otherwise connected with it; but their bases are retracted within the *cavity of the skull*, surrounded by muscles, whilst generally only their points project outside the mouth. In this case the appendages in question can be protruded and retracted, but not moved laterally against each other. They may be used as pungent-instruments, but not for biting; and in this case the skull has generally much less consistency than where the mandibles articulate with it." . . . . "But, besides these two principal types, there exists a third, which, as it were, connects them. In some insects the mandibles and maxillæ do not properly articulate with the skull, and are retracted within the cavity of the skull, so that only their apices are visible outside the mouth; but, nevertheless, they are calculated for biting, and capable of being moved laterally against each other. The absence of articulation or other connection with the skull allows of their being to some extent pushed out of the mouth when in use, which is neither possible nor necessary in the case of free-biting mandibles and maxillæ; at the same time it is to be observed that, in the case of this intermediate type, the process of protrusion is effected by a special contrivance, entirely different from that whereby the mandibles and maxillæ of the ordinary retracted type are moved forwards and backwards. This intermediate type, which reminds us of the arrangement of the mouth of the Crustacea, is amongst insects only found in THYSANURA (Collembola), and affords one of the two principal characters of this order (or sub-order), the other being this, that they remain in the larval stage without undergoing any metamorphosis at all. Not only are the individuals possessing perfectly developed sexual organs without even a vestige of wings, but the segmentum mediale forms a complete ring as in larvæ, and they are unguligrade; their eyes, finally, when they do occur, are single or, at utmost, agglomerated.

This larval character is typical for these insects; and we cannot fancy winged species interspersed amongst them in the same way as apterous species occasionally occur in the families of typically winged insects."

In short, there are among Hexapods three principal forms of mouth:

First, the mandibulate, in which the mandibles and maxillæ are attached externally, and are more or less powerful and adapted for biting and chewing.

Secondly, the suctorial, in which the mandibles and maxillæ are attached internally, and are not opposite, but parallel, and intended for pricking; and—

Thirdly, the type presented by *Campodea* and the COLLEMBOLA; in which the mandibles and maxillæ are attached internally, and are far from strong, but still have some freedom of motion, and can be used for biting and chewing soft substances.

This description of the mouth agrees in all essential points with that which I gave in my first memoir on the group,[1] but I quote it here as the account given by an independent observer. It seems to me to throw no little light on the possible course of insect evolution. Assuming that certain representatives of this parent group found themselves in circumstances which made a suctorial mouth advantageous, those individuals

a typically mandibulate group would arise, such as *Nicoletia* (if, indeed, *Nicoletia* be not a larval form); but here, again, the development might be continuous and the activity uninterrupted, as in the case of the grasshoppers, locusts, crickets, cockroaches, &c.

There is yet a third possibility, namely, that during the first portion of life the power of mastication should be advantageous, and during the second that of suction, or *vice versâ*. A certain kind of food might abound at one season and fail at another; might be suitable for the animal at one age and not at another: now, in such cases you would have two forces acting successively on each individual, and tending to modify the organization mouth in different directions.

It will not be denied that the ten thousand variations in the mouth-parts of insects have special reference to the mode of life, and are of some advantage to the species in which they occur. Hence, no believer in natural selection can doubt the possibility of the three cases above suggested, and the last of which seems to me to explain the possible origin of species which are mandibulate in one period of life and not in another. The change from the one condition to the other would, no doubt, take place during a change of skin. At such times we know that, even when there is no change of form, the temporary softness of the organs often prevents the insect from feeding for a time—as, for instance, in the case of the silkworm. When, however, any considerable change was involved, this period of fasting would be prolonged, and would lead to the existence of a third condition, that of the pupa, intermediate between the other two. Since other changes are more conspicuous than those relating to the mouth, we are apt to associate the pupa state with the acquisition of wings, but the case of the Orthoptera (grasshoppers, &c.) is sufficient proof that the development of wings is perfectly compatible with continuous activity; so that in reality the necessity for rest is much more intimately connected with the change

in the constitution of the mouth, although in the majority of cases the result is also accompanied by changes in the legs and in the internal organization.

It is, however, obvious, that a mouth like that of a beetle could not be modified into a suctorial organ like that of a bug or a gnat, because the intermediate stages would necessarily be injurious. Neither, on the other hand, could the mouth of the Hemiptera be modified, for the same reason, into a mandibulate type like that of the Coleoptera. But in *Campodea* and the COLLEMBOLA we have a type of animal closely resembling certain larvæ which occur both in the mandibulate and suctorial series of insects, in Lepidoptera, Hymenoptera, Orthoptera, and Coleoptera, and which possesses a mouth neither distinctly mandibulate nor distinctly suctorial, but constituted on a peculiar type, capable of modification in either direction by gradual changes without loss of utility.

These considerations seem to me strongly to support M. Brauer's conclusion, that in the very interesting genus *Campodea* we have a form closely resembling the parent stock, from which the various orders of insects have arisen; and at the same time they seem to me to throw some light on the opposite mouth-types which occur in the same species throughout so

is extremely delicate, but at the same time very active. The *Campodea*-like larva of *Sitaris*, having to face the open air, has a harder skin; necessity takes it into situations where the true *Campodea* would rapidly shrivel and dry up.

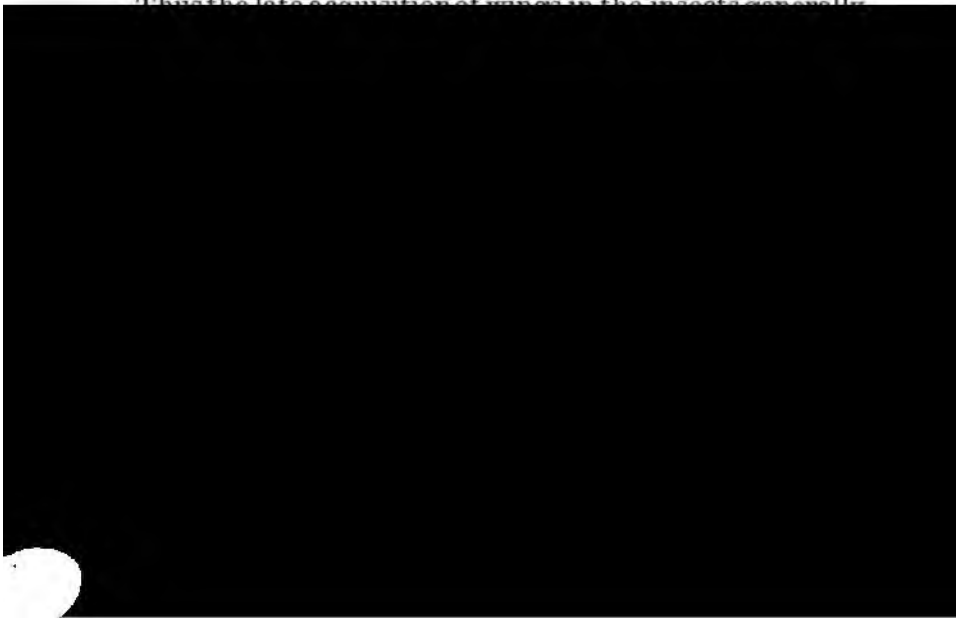
The larvæ of Lepidoptera and of *Tenthredinidæ* live on plants; activity to them would be useless, and they do not possess it. The larvæ of most Hymenoptera—for instance, of the bee, wasp, ant, *Cynips*, &c.—of Diptera, and of some Coleoptera, live in circumstances which call for even less locomotion, and have relapsed almost into the condition of their far-distant vermiform ancestor.

Before concluding, I must say a few words about the probable nature and origin of the wings. Whence are they derived, why are there normally two pairs, and why are they attached to the meso- and meta-thorax? These questions are not less difficult than interesting. It seems to me that the wings of insects originally served for aquatic and respiratory purposes. From the various modes by which respiration is effected among the different groups of aquatic insects, we are justified in concluding that the original insect stock was, like the *Campodea*, a land animal.

But in aquatic insects there is a tendency to effect the respiration through the delicate membranous covering of more or less foliaceous expansions of the skin. In the larvæ of *Chloëon*, for instance, which singularly resembles *Campodea*, several of the segments are provided with such foliaceous expansions, which, moreover, are in constant agitation, and the muscles of which in several remarkable points resemble those of the true wings. It is true that in *Chloëon* the vibration of the so-called branchiæ is scarcely, if at all, utilised for the purposes of locomotion. The branchiæ are, in fact, placed too far back to act efficiently. The situation, however, of these branchiæ differs in different groups, and it seems indeed probable that originally there would be a pair on each segment. In such a case

those branchiæ which were situated near the centre of the body, neither too much in front nor too far back, would serve the most efficiently as propellers. The same causes which have determined the position of the legs would affect also the wings. Thus a division of labour would be effected, the branchiæ on the posterior segments of the thorax would be devoted to locomotion, those of the abdomen to respiration. This would tend to increase the development of the thoracic segments, already somewhat enlarged to receive the muscles of the legs.

That wings may be of use to the insects under water is proved by the very interesting case of *Polynema natans*, which I discovered in 1862,[1] and which uses its wings to swim with. This, however, is a rare case, and it would seem that the principal use of the wings was primordially to enable the mature forms to pass from pond to pond, thus securing fresh habitats, and perhaps avoiding in-and-in breeding. If so, the development of wings would tend to be relegated to a late period of life; and by the tendency to the inheritance of characters of corresponding ages, to which Mr. Darwin has called attention,[2] the development of wings would be associated with the maturity of the insect.



CHAPTER IV.

COLLEMBOLA.

General Description.

In the Collembola, as in true insects, the body is divided into three distinct sections—the head, thorax, and abdomen. The head bears the antennæ, the eyes, and the mouth-organs; to the thorax are attached the three pairs of legs; to the abdomen, the sucker, the catch, and the saltatorial appendage, or spring.

The skin is clothed with hairs, and in several genera with scales. In addition to the ordinary hairs, which are of various lengths, some genera bear others of peculiar forms; for instance, *Degeeria* has club-shaped hairs (Pl. LXV, fig. 8), and others which more or less resemble a bow (Pl. LXV, fig. 7), not only in the general form, but in having a notch at the end, closely imitating that by means of which the bowstring is attached. Several species also have on their feet, and in some cases, as in *Smynthurus fuscus*, on the saltatorial appendage, one or more tenent hairs, that is to say, hairs which are swollen at their extremity, and which assist the animal to retain its hold on slippery surfaces.

The scales are of very various forms and sizes, even in the same species; they are generally colourless, but in some species, especially in the genus *Lepidocyrtus*, are beautifully iridescent. While, however, the scales do not generally offer specific characters either in their form or magnitude, the structure of the scale is often very characteristic. I will not, however, enlarge on this subject, as I shall hope to append a special

chapter on the scales, by my friend Mr. Beck, who has studied them carefully, and than whom no one is more competent to speak on the subject.

The head.

The head does not generally show any traces of segmentation. In most cases it is somewhat compressed from above and below; in others, on the other hand, as in *Smynthurus*, from in front and behind, thus being, like the rest of the body, increased in height at the expense of the length. In *Lepidocyrtus* the head is attached to the body at an angle, and in some species of that genus the thorax projects so much forwards that when the animal is seen from above the head is completely hidden. The hairs or scales, as the case may be, on the head, resemble those on the general surface of the body.

Laboulbéne has called attention[1] to a curious organ, which he observed in *Lipura maritima*, and which, from its position on the surface of the head—immediately in front of the eyes—he proposed to call "organ prostemmatique ou ante-oculaire." Inasmuch, however, as a corresponding organ occurs in some species where the eyes are wanting, Tullberg has suggested,[2] and I think with reason, that the term "post-antennal"

malvacées indigènes, entre autres les *Malva* et les *Althæa*. Quelque soin que j'aie mis à chercher si du point central il naissait un poil allongé ou toute autre production dermique, je dois dire que je n'en ai point trouvé."

Tullberg suggests, though with some doubt, that the so-called eyes of *L. fimetaria* are in reality homologous, not with the eyes of other COLLEMBOLA, but with the post-antennal organs of *L. maritima*, which they more nearly resemble both in position and in structure. The so-called "eye" of *L. fimetaria* consists of minute, circular, colourless, elevations (Pl. LVI, fig. 26), arranged in two almost contiguous rows, and which are only visible under a high power and with a good illumination. Similar organs occur in other species of the same genus, as, for instance, in *L. Burmeisteri* (Pl. XLV, fig. 16). Indeed, they will probably be found in all the true *Lipuræ*. I have always felt a difficulty in regarding this curious structure as an organ of vision, and am disposed to adopt Tullberg's suggestion.

The eyes are situated behind the antennæ, on the upper surface of the head. They consist of distinct ocelli, collected together, however, in two groups, one on each side of the head, and generally situated on a dark patch. The number and arrangement of the ocelli afford good specific and generic characters, though in many cases, from their minute size, the curvature and delicacy of the surface on which they are placed, and the hairs or scales by which they are surrounded, they are not very easy to determine. In most cases the ocelli are approximately equal in size, but in some genera one or more are much smaller than the rest.

The number and arrangement of the ocelli in the different genera are shown in Pls. LV and LVI. *Templetonia* has a single ocellus on each side; *Orchesella* has six, arranged in the form of an S; *Tomocerus* and *Isotoma* have seven; *Degeeria*, *Lepidocyrtus*, *Smynthurus*, and *Papirius*, eight.

The number is not, however, always the same in all the species of a genus. Thus, *Lipura maritima* has five ocelli on each side, while *L. laricis*, according to Nicolet, has eight. Lastly, *Beckia* and *Tritomurus* have no eyes.

The antennæ are situated on the upper surface of the head in front of the eyes. They vary considerably, and offer useful generic, as well as specific, characters. We may consider the normal antenna as consisting of four equal segments. They are generally situated on a more or less salient tubercle, which, in some cases, might be regarded as an additional segment.

In *Smynthurus* (Pl. LV, fig. 1) the basal segment of the antenna is short, the other three successively increasing in length, each being nearly double as long as its predecessor. The terminal segment is divided into more or less numerous subsegments. In *Papirius*, on the contrary (Pl. LV, fig. 5), the apical segment, though similarly subdivided, is little longer than the basal. In *Dicyrtoma* the antennæ are described as 8-jointed.[1]

The genus *Orchesella* (Pl. LV, fig. 9) has long, 6-jointed antennæ; the basal and third segments are short; the second and fourth, always counting from the base, are longer; the two apical, again, about equal to one another, and together almost as long as

I have been unable to find one which was perfect in this respect.

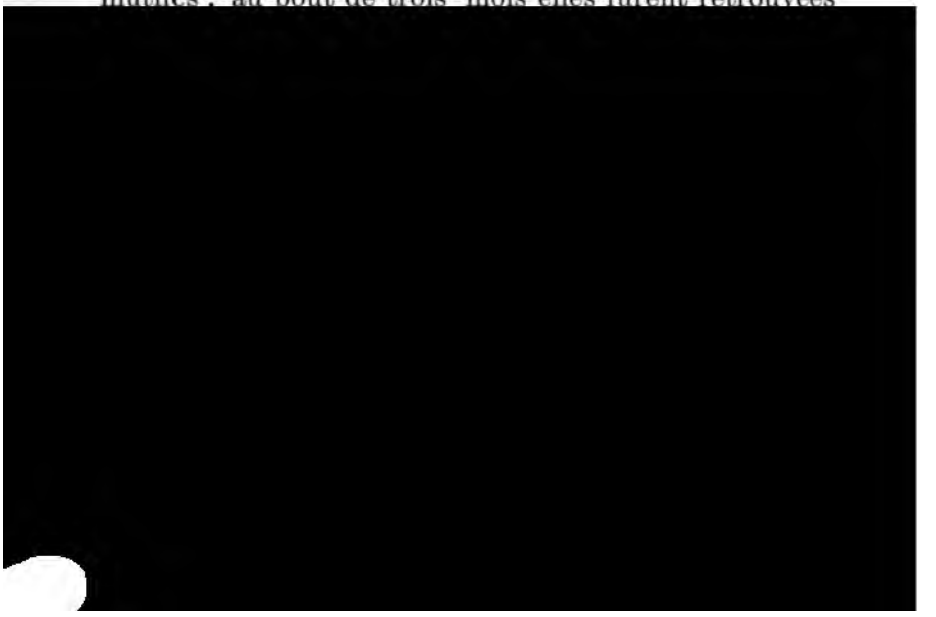
In *Templetonia* the apical segment is the longest and is ringed, while the third, on the contrary, is simple. The genera *Achorutes* and *Podura*, as well as the species belonging to the two small families LIPURIDÆ and ANOURIDÆ, all have the antennæ quite short, simple, and 4-jointed.

In his original description of *Isotoma stagnorum* (*Podura aquatica cinerea*) De Geer[1] remarked with surprise that the antennæ were not always symmetrical, but that, while four was the normal number of segments, many specimens had one antenna with four, as usual, the other with only three. The individual which he figured was in this condition. Latreille, also, in his 'Organisation extérieure et comparée des Insectes de l'Ordre des Thysanoures,'[2] observes that the antennæ of the *Poduridæ* "sont sujets à des monstruosités, puisque je possède un individu où l'une des antennes a trois articles, et l'autre deux. Je les ai examinées, l'animal étant vivant, et je n'ai aperçu aucune trace de mutilation. Les variations ainsi que les anomalies relatives au nombre des yeux lisses semblent indiquer que la nature tâtonne ici, en quelque sorte, et qu'il ne faut pas dès-lors attacher une grande importance à ces caractères numériques."

M. l'Abbé Bourlet gave as a character of his genus *Heterotoma* (a name which he subsequently changed for *Ætheocerus*), which is composed principally, but not entirely, of the species forming Templeton's genus *Orchesella*, that the segments of the antennæ varied from 2 to 5, those even of the same individual being often dissimilar in the number of their segments. He was aware that M. Macquart regarded these differences as either abnormal or accidental; but he rejected this explanation because—" 1°. Dans le cas où les antennes sont inégales, le dernier article de la

[1] 'Act. Soc. Reg. Sci. Upsal.,' 1740, p. 64.
[2] 'Nouv. Ann. du Museum,' v. i, p. 186.

plus courte, quel que soit son rang numérique, n'est jamais conforme à l'article correspondant de l'autre antenne; 2°. il affecte constamment une forme analogue à celle de l'article terminal, ou le cinquième; 3°. il en est de même pour les antennes égales, mais ayant moins de cinq articles; dans ce cas, le dernier est toujours plus gros et plus long que le terminal de l'antenne normale, quoique ayant une forme analogue et la même couleur; 4°. on n'aperçoit à l'extrémité de l'article aucune trace de fracture; 5°. plusieurs jeunes Podurides et un grand nombre d'adultes ont été trouvées ainsi conformées; le nombre de celles-ci était, à l'egard des *Ætheocerus* à antennes de cinq articles, comme cinq est à huit; 6°. cette conformation des antennes ne se rencontre que rarement dans les autres Podurides; 7°. toutes les fois que dans les autres genres on trouve des Podurides dont les antennes ont été brisées, la cicatrice est toujours visible et la forme des articles n'a pas varié; 8°. j'ai renfermé dans des vases une certaine quantité d'Ætheocerus dont les antennes offraient les différentes conformations observées par moi; j'y ajoutai plusieurs congénères qui avaient ces organes brisés au moment où elles furent trouvées, ou à qui je les avais moi-même mutilés; au bout de trois mois elles furent retrouvées



segments show no trace of fracture; but it is equally certain that this is also the case in mutilated specimens after a change of skin. If one removes part of the antenna of an *Orchesella*, the injury is very apparent until the creature moults, after which the end of the antenna becomes more or less regular, according to the time which has elapsed between the wound and the moult. M. Bourlet states that this condition of the antennæ occurs only among the *Heterotomæ;* this, however, is by no means the case. Most of the other genera, indeed, having shorter antennæ, are less liable to injury; and mutilated specimens are therefore much less frequent among them than in the genus *Orchesella*.

Tomocerus, however (*Macrotoma*, Bourlet), also has long antennæ; and here the mutilations are so frequent that, as already mentioned, Bourlet actually describes the genus as having 3-jointed antennæ, four being the right number. I myself, though I have examined hundreds, have very rarely met with a full-grown specimen of *T. longicornis* with perfect antennæ. This almost invariable mutilation is an extremely curious fact. M. Bourlet affirms that really mutilated specimens always show the "cicatrice." The term is scarcely correct; and, as I have already observed, the mark only remains until the next moult.

Lastly, M. Bourlet states that, having mutilated the antennæ of several specimens, and placed them with others in which the antennæ were unsymmetrical, he found them at the end of three months exactly in the same condition. This statement is quite contrary to my invariable experience, and, unless he tried it in very cold weather, he must, I think, have made a mistake. In summer the moults always follow one another at comparatively short intervals; and at the first moult after mutilation I have always found a considerable tendency to reparation, which becomes still more manifest after two or three changes of skin.

The explanation of M. Bourlet's mistake, however,

is to be found in the fact that an antenna once seriously mutilated never regains its normal number of segments. Such, at least, has been my experience. It is possible that very young specimens may have more complete powers of reparation. I doubt very much, however, whether it is so, because I have observed in *Chloëon* (*Ephemera*) that the terminal segments of the antenna, if once removed, are never replaced (although the antenna continues to grow), so that not one specimen in twenty of those which I examined had perfect antennæ when the insects were half-grown.

As illustrating the partial recovery which takes place, I will take the following cases from my note-book.

On the 11th of April, I removed the terminal portion of the right antenna of a pale *Orchesella cincta*, at the middle of the second segment, as shown in Pl. LXII, fig. 1. On the following day the animal moulted, and the mutilated antenna was as in fig. 2, the second segment being a little elongated, but not much altered, probably on account of the short time which intervened between the mutilation and the moult. On the 19th of April the antenna was as in fig. 3, and consisted of three segments. The second

case. The antenna was 3-jointed, the two apical segments presenting the same peculiarities as in the preceding specimen. At the next moult the terminal segment elongated as in fig. 7; but no further change took place.

I made a few more similar experiments with similar results, but was reluctant to multiply them too much, being unwilling to cause unnecessary pain, and seeing no reason to expect any materially different results.

It is remarkable that in all these cases the terminal segment acquires a length even greater than that which it possesses in normal specimens. This is well shown also in *Tomocerus*. In this genus I have satisfied myself, both by direct experiment, and also by watching specimens which had been accidentally mutilated, that if the terminal segment is removed it is never replaced, though the third segment acquires an unusual length. I have even seen specimens, under these circumstances, in which the third segment acquired a length almost equal to that of the third and fourth segments of a normal antenna.

The descriptions given by different naturalists of the mouth-parts of these animals have been very dissimilar. Fabricius mentions mandibles and maxillæ, labium and two pairs of palpi, consisting respectively of five and three segments. Latreille does not hesitate to characterise this description as being "absolument fictive." Assuredly it is absolutely incorrect; but is it not more probable that Fabricius should have mistaken the species he examined, than that this great naturalist should have voluntarily committed a fault so certain of detection?

The account given by Latreille himself is little more satisfactory. "La lèvre inférieure," he says, "se compose de deux petites lames longitudinales, parallèles, avec trois ou quatre divisions setacées, au bord supérieur de chaque, et dont l'une est peut-être un palpe. Quelques autres pièces, et qui, à en juger par la couleur brune, on tirant sur celle de la corne, de leur

extrémité, sont probablement les mandibules et les mâchoires, remplissent les côtés. J'ai aperçu, à chacun d'eux, un petit corps arrondi, portant une soie, et que je présume être un palpe maxillaire. Le centre de la bouche est mou, vésiculeux, et cintré supérieurement par le labre. J'ai souvent examiné, avec une grande attention la bouche de ces insectes étant encore en vie : je n'en ai vu saillir aucune partie, et il m'a été impossible d'en déterminer, avec certitude, l'organisation. J'ai consulté anciennement sur cet object mon ami Savigny, et je me rappelle qu'il me répondit qu'il n'avait pas été plus heureux que moi."

This description is vague as well as inaccurate, and was evidently written in haste, as Latreille could not have intended to attribute to mandibles the possession of *maxillary* palpi. I quote the passage, however, because, if I have myself fallen in error, I may well be excused for having misunderstood a structure which baffled Latreille, and even apparently the illustrious Savigny himself.

However this may be, the mandibles (Pl. LXIV, fig.2 and 10) and first maxillæ (Pl. LXIV, fig. 9) are easy enough to identify, and this has been correctly done by Nicolet and Bourlet. The latter distinguishes—" 1°, un épistome paraissant arrondi ; 2°, un labre membraneux,

as, for instance, by V. Siebold in his 'Anatomy of the Invertebrata.'

In my first communication on this subject to the Linnean Society (February, 1862) I described the mouth parts as follows:—1st, an upper lip; 2nd, a pair of mandibles; 3rd, a pair of maxillæ; 4th, a pair of small palpi; 5th, a pair of organs probably homologous with the second maxillæ; 6th, a central organ, corresponding to the so-called "langue vésiculeuse" in the *Lepismidæ;* 7th, the lower lip.

Taking *Tomocerus* as a typical species, the labrum, (Pl. LXIV, fig. 4.) is a simple, entire, quadrate, horny lobe, somewhat broader at the base than at the apex, with a few scattered hairs, and on the front margin a row of teeth or minute bristles at a little distance from the free border.

The mandibles (Pl. LXIV, fig. 2) are long and somewhat cylindrical, with a large gaping orifice, through which the muscles pass into the head. At some distance from the teeth is a raised molar surface, which is covered with minute, rather blunt teeth, and, in conjunction with the corresponding portion of the opposite mandible, evidently serves the function of mastication. The terminal incisive portion is generally dissimilar in the two mandibles, the one having generally a tooth more than the other. This part of the mandible diminishes rapidly in thickness towards the tip.

The maxillæ (Pl. LXIV, figs. 1 and 8) are a little shorter than the mandibles; they are narrowest towards the upper end and widest towards the middle. The upper extremity is terminated by a somewhat complicated system of teeth, which appear to have some power of independent movement. The body of the maxilla is strengthened by a chitinous framework; down each side runs a strong rib, while the two are connected at the centre by a transverse piece, which is also continued on the inner side a little way beyond the rib, and curves at the same time, so as partly to surround the softer parts. The two lateral ribs con-

verge to meet one another at the base as at the apex. At the former, however, they enclose a space which has the form of an acute triangle, while at the basal end they curve round to meet one another. At the base the chitine is rounded off on the outer side, but is produced into a sharp point on the inner edge.

The palpi (Pl. LXIV, fig. 6) are short, 1-jointed, rounded, but not tapering at the free end, and with two longish setæ and one or two minute hairs, none of them, however, attached at the apex.

The second pair of maxillæ are membranous and delicate. Pl. LXIV, fig. 7, represents their form in *Tomocerus;* in *Smynthurus* they have at the extremity two teeth of equal size, on the basal side of these are three more or less projecting lobes, and then follow a number of small teeth, which end at a point where the two maxillæ converge towards the middle line so as to touch one another. They are closely attached to the ligula (Pl. LXIV, fig. 3), which is membranous and very delicate.

The under lip (Pl. LXIV, fig. 5) is stronger, and consists of two more or less quadrate lobes.

It must be observed, however, that the mouth of the *Lipuræ* is not mandibulated. Meinert's[1] description of the mouth parts is substantially similar, but the organs which I had considered as the second pair of maxillæ he regards as labial palpi. He lays just stress on the importance of the characters afforded by the mouth parts with reference to the true position of *Podura* and its allies. While agreeing with *Lepisma* and the mandibulated series of insects in the possession of true mandibles, the COLLEMBOLA differ from them in the important point that, instead of being external, their mandibles and maxillæ are retracted within the cavity of the skull. In some respects, therefore, they are intermediate between the mandibulate and haustellate insects.

[1] 'Naturhistorisk Tidsskrift,' 3 ser. 3, vol. iii, p. 400, Copenhagen, 1865; and 'Ann. and Mag. Nat. His.,' 1867, p. 361.

The thoraæ.

The thorax consists, as usual, of three segments, prothorax, mesothorax and metathorax, each bearing a pair of legs. The prothorax is generally the smallest of the three, and is, indeed, in many genera completely covered by the mesothorax, in consequence of which the mesothorax has been more than once mistaken for the prothorax;[1] thus, in *Lepidocyrtus* the projecting segment is the mesothorax, and not the prothorax, as might at first have been supposed. The three pair of legs do not generally differ much from one another in size; the anterior pair are generally, however, the shortest and weakest, the hinder pair the longest and strongest. They consist of five segments. The legs are always clothed with hairs, and generally have a certain number which are much longer and stronger than the rest. Some of the species also have one or more tenent hairs near the foot. In *Podura aquatica* the legs terminate in a strong curved claw; but the great number of species are biunguiculate, the two claws not being terminal and opposite, but placed one above the other. In *Smynthurus* and *Papirius* the feet are peculiarly formed (Pl. LV, figs. 4 and 7; Pl. LXV, figs. 1—4), and offer good specific characters.

The abdomen.

The abdomen is globular in the *Smynthuridæ* and *Papiriidæ*; linear in the *Poduridæ*, *Lipuridæ*, and *Anouridæ*. It consists of six segments, which, however, are not well marked in the globular species. The anterior segment is attached to the thorax by its whole base. Each segment is composed of two arches, one dorsal and one ventral. Excepting the last or two last, the dorsal arches are subequal in the *Anouridæ*

[1] See, for instance, Latreille, 'Nouv. Ann. d. Museum,' 1832, p. 186.

and *Lipuridæ*, as well as in *Podura* and *Isotoma;* in *Orchesella*, *Tomocerus*, *Templetonia*, *Beckia*, *Seira*, *Lepidocyrtus*, and *Degeeria*, on the contrary, that of the third or fourth abdominal segment is considerably larger than the rest.

M. Nicolet describes four pairs of spiracles placed on the superior arches of the four first segments of the abdomen; "ils occupent le milieu de chaque bord latéral des segments ci-dessus mentionnés." Warned by the material differences which, as we shall presently see, exist in two groups otherwise so nearly allied as *Smynthurus* and *Papirius*, I should not like to assert that these spiracles do not exist at all, but I have not been able to find them in any of the *Poduridæ* which I have dissected.

Underneath the anterior abdominal segment is the ventral tube, or sucker. In *Podura*, *Lipura*, and the allied genera, this organ is a simple tubercle; divided into two halves by a central slit; in other genera, as, for instance, in *Orchesella* and *Tomocerus*, the tubercle is enlarged, and becomes a tube divided at the free end into two lobes. In the *Smynthuridæ* and *Papiriidæ* the organ receives a still further and very remarkable development; from the end of the tube the animal can

No one, indeed, who has watched the habits of the COLLEMBOLA, can doubt its function.

If a *Smynthurus* is laid on its back—a position from which it has some difficulty in recovering its feet—and if, while it is in this attitude, a piece of glass is brought within its reach, the animal will endeavour to seize it with the feet, but at the same time it will project one or both of the ventral tentacles and apply it, or them, firmly to the glass, emitting at the same time a drop of fluid, which, no doubt, gives a better hold. In the parallel case of the *Poduridæ*, M. l'Abbé Bourlet supposes that the ventral tube acts as follows:—"1°. qu'il sert à ces insectes à se maintenir sur les surfaces perpendiculaires en y faisant le vide; 2°. que le liquide excrété par lui sert à humecter la queue et la rainure; 3°. qu'il supplée à la faiblesse des pattes dans les chutes qui suivent les sauts." I am therefore disposed to agree with him in so far as he denies that the adhesive power depends altogether on the viscous fluid; but, on the other hand, I cannot attach much importance to his two latter suggestions. De Geer well understood the use of this curious organ. He says, "Quand la Podure [under which name he includes the present genus *Smynthurus*] marchait contre les parois du poudrier, il lui arrivait souvent de glisser; c'était comme si les pieds lui manquaient, de façon qu'elle était sur le point de tomber; dans l'instant même, les deux filets parurent et furent lancés avec rapidité hors de leur étui, s'attachant dans le moment au verre par la matière gluante dont ils sont enduits, en sorte qu'alors la Podure se trouvait comme suspendue à ces deux filets." Nicolet gives a similar explanation of their function, and, like De Geer, attributes the adhesiveness to the glutinous matter which they secrete.

The next abdominal appendage is the "catch" (Pl. LVII x, Pl. LVIII E, and Pls. LIX and LX). As will be seen by the latter figures, it is in *Tomocerus* situated on the ventral side of the third abdominal segment. It is described by Nicolet as "une petite pièce blanche,

saillante, multiarticulée," while in the species I have examined it is horny, and has only two segments. Thus, in *Tomocerus longicornis* it consists of a basal portion and two short arms, each with four teeth on the outer margin. It only exists in certain genera.

The great saltatorial appendage is attached in most cases to the underside of the penultimate (Pl. VIII, figs. 2 and 3; Pl. XVI. See also Pls. LVII—LXI), but in *Podura* and *Achorutes* (Pls. XL, XLI) to that of the antipenultimate segment. It is not, therefore, in fact, homologous in these groups. Nor is it strictly correct to call it, as Nicolet and others have done, a tail. It consists of a basal segment and two appendages, which are sometimes 2-jointed and sometimes consist of a single piece each. This organ has generally been considered as peculiarly characteristic of the COLLEMBOLA, but, on the contrary, it is altogether wanting in the *Lipuridæ* and *Anouridæ*, which in consequence are non-saltatorial. Moreover, as already mentioned, although a saltatorial appendage occurs in all the *Smynthuridæ*, *Papiriidæ*, *Degeeridæ*, and *Poduridæ*, the saltatorial organ of the latter family is not really homologous with that of the majority of the group. In fact, therefore, we find among the COLLEM-

forward as far as the catch, which passes between the two branches and under the basal segment, thus retaining the whole organ in its place.

Specific differences.

The colouring varies greatly in different specimens, though if a large number of individuals are compared together a common plan can generally be detected. All species founded on single specimens must, however, be regarded as unsatisfactory, and, indeed, in all cases it is desirable to rely as much as possible on differences of form. The shape of the saltatorial appendage, and of the feet, afford excellent specific characters in many genera.

Among the parti-coloured species, the magnitude of the differently coloured areas often differs greatly in different specimens. Of this *Orchestella cincta* and *Isotoma trifasciata* afford characteristic examples.

Having examined a very large number of specimens of most of the more common species, I have found myself compelled to reduce considerably the number of supposed species. Future researches, while they will undoubtedly reveal new forms, will, I believe, carry the process of condensation still further. Indeed, I doubt whether there is any case of two species which differ in colour only, inhabiting the same localities, and using the same food. Such species, founded on chromatic differences only, will therefore, I believe, eventually prove to be mere varieties.

On the other hand, there are some cases in which species essentially distinct are at first sight curiously similar. In some instances these may almost be regarded as approximating to mimetic species. For instance, *Isotoma viatica* (Pl. XXXVI) and *Lipura corticina* (Pl. XLV), though belonging to different families, are curiously similar as regards their dorsal aspect.

Habits.

The majority of the COLLEMBOLA live on decaying vegetable matter, and they are to be found in great numbers in almost all damp places. Some few species, for instance *Podura aquatica*, *Smynthurus aquaticus*, and *Isotoma aquatilis*, frequent the surface of standing water. Some species of *Smynthurus* live on the leaves of plants; *Seira domestica* frequents houses; *Lepidocyrtus curvicollis* is found in cellars; *Achorutes maritimus* and *Lipura maritima* occur on the sea-shore; but, as a general rule, we may say that the species of this group are to be found in loose earth, among dead leaves, under bark, and in similar situations. From their timid and retiring dispositions we know as yet but little with reference to their habits. The sexual differences appear to be but slightly marked, and are known to us only in a few species, in which the males appear generally to be smaller than the females. Only in one, *Smynthurus luteus*, have I ever observed anything approaching to a courtship.

But although we can as yet say so little concerning the habits of this group, various considerations clearly show that, if properly understood, they must present some points of much interest, and be far less simple than might at first be supposed.

In the first place, the organization of the group seems in some respects but ill adapted to the mode of life. We may, indeed, be sure that this incongruity is only apparent. Yet the possession of a powerful saltatory apparatus appears to be a fantastic provision for a species which lives in the chinks and crannies of bark, in the interstices of fungi, or buried among decaying leaves.

Nicolet, indeed, observes[1] that "Quoi qu'il en soit, ces petits animaux sont encore un exemple de la sage économie avec laquelle la nature a su donner à chaque être les organes qui lui conviennent et rien de plus;

[1] 'Mem. sur les Podurelles,' p. 41.

destinés à vivre sous les écorces des vieux arbres ou dans l'intérieur de la terre, les Achorutes et les Anurophores n'ont point d'appendices saltatoires; ils leur seraient inutiles; mais une queue forte et d'une action puissante devenait nécessaire aux Podurelles qui, vivant dans les broussailles et dans les pierres, avaient souvent des obstacles difficiles à franchir."

As a matter of fact, however, the saltatory and non-saltatory species are habitually found together under the same old board, or in the same decaying heap of leaves; and in fact the species of the group frequent places where jumping is impossible, so that the saltatorial power is but occasionally exercised. On the other hand, it must be admitted that in certain cases it is very useful, but this still more shows how little we can realise the conditions of Collembolan existence, since it is evident that the non-saltatory species must possess some counterbalancing advantage by which they are enabled to hold their own in the struggle for existence.

The presence of blind species gives rise to similar reflections. Thus, *Beckia albinos* and *B. argentea*, which have no eyes, will be found living together with eyed species, and moving about with equal rapidity and decision. Indeed, *B. albinos* is a particularly restless and active species. Probably in this case the antennæ are peculiarly sensitive.

Again, it might *à priori* have been considered that the very long antennæ of *T. longicornis* must be very ill suited to its mode of life.

Lastly, it may be mentioned that the function of the so-called "post-antennal organ" is entirely unknown to us.

Internal Anatomy.

According to Nicolet (l. c., p. 46), the digestive organs of the Collembola consist of six parts—namely, "l'ésophage, le jabot, le ventricule chylifère, les vaisseaux hépatiques, l'intestine grèle, et le cæcum." By

the "cæcum" he evidently means the rectum. Nicolet gives his description of these parts as applicable to the order generally, and does not mention which genus or genera he particularly examined. In those which I have dissected, and particularly in *Tomocerus*, *Orchesella*, and *Smynthurus*, the digestive organs pass straight through the body without any circumvolutions from the head to the tail, and fall into three divisions, the œsophagus, the stomach, and the rectum. I think there are no Malpighian vessels.

Von Olfers, the only naturalist who has, since my paper in the 'Linnean Transactions' (which, however, he does not appear to have seen), occupied himself with the anatomy of the Collembola, also describes and figures the intestinal canal, at least in *Orchesella*, as a straight tube passing directly from one end of the body to the other, and falling into three divisions, the œsophagus, the ventriculus, and the rectum.

The œsophagus is rather long, narrow, and composed of an inner chitinous membrane thrown more or less into folds, and a cellular envelope, outside which, again, is a loose and very delicate membrane. Nicolet describes a crop as existing between the œsophagus and the stomach; but he admits that it is only "une simple dilatation de l'ésophage, dont le diamètre varie selon que l'insecte a plus ou moins mangé."

Von Olfers was, I believe, the first to observe that from one side of this swelling, which is somewhat thickened, rises an elongated membranous tube. This he regards as the salivary gland; and he considers that it really rises immediately behind the mouth, passing backwards along the œsophagus, to which, however, it is so firmly attached that "ne vi quidem separari possint" (they can hardly be separated even by force). In fact, if the "salivary gland" and the stomach be pulled in opposite directions, as far as my experience goes, the former gives way.

The stomach is capacious, and extends in a straight

line from the posterior end of the œsophagus to the commencement of the intestine. It is of even width throughout. Externally it is provided with both longitudinal and transverse muscles, which give it a pretty, reticulated, appearance. The transverse series is the most numerous, the spaces between the muscles being something less than twice the width of the muscles themselves. In some places they anastomose frequently. This appeared to be more the case in some specimens than in others. The distances between the transverse muscles are much larger. The stomach contains, besides the food, a large number of clear round cells containing smaller cells or vacuoles. It is, moreover, often occupied by a number of Gregarinas.

According to Nicolet, the Malpighian vessels are probably six in number. He says, "Les vaisseaux hépatiques, dont je n'ai pu au juste reconnaître le nombre, mais que je crois être de six, sont tubuleux et filiformes ou du même diamètre dans toute leur longueur; ils sont insérés immédiatement au-dessus du rétrécissement pylorique; leur longueur égale à peine la moitié de celle du ventricule chylifère; du reste, leur extrême ténuité et leur peu de consistance ne m'ont pas permis de les étudier en détail." Von Olfers also describes them as "filiformia, tenerrima;" but he only saw four. When the Malpighian vessels are very numerous, it is naturally difficult to count them; but as they are in this group so few, Nicolet can certainly not have seen them very distinctly when he remained in doubt as to the number.

For my own part I have examined *Orchesella fastuosa*, the species in which they are figured by Von Olfers, as well as *Tomocerus plumbeus*, *Smynthurus*, and other species, but have never been able to satisfy myself that any such organs really exist. They are, moreover, wanting in *L. maritima* according to Laboulbéne.[1]

The intestine has, in *Tomocerus*, a length of about

[1] 'Ann. Soc. Ent. France,' 1864, p. 715.

$\frac{1}{35}$ of an inch. It is straight, and of even diameter. It is strongly muscular, being provided throughout its whole length with transverse muscles, which lie close together, and are about $\frac{1}{1500}$ of an inch in diameter.

The internal respiratory organs were first described by Nicolet, according to whom, "Les ouvertures trachéennes ou stygmates, dont je n'ai pu découvrir que huit, sont placées par paires sur les arceaux supérieurs des quatre premiers segments de l'abdomen. La couleur de leur péritrême, qui est la même que celle du corps de l'insecte, les rend très-difficiles à apercevoir; leur forme est lunulaire; ils occupent le milieu de chaque bord latéral des segments ci-dessus mentionnés, mais à une distance de ce bord égale au septième environ du diamètre transversal de l'insecte."[1]

Speaking in a subsequent passage of the tracheæ themselves, he says,[2] "C'est également sur les lignes latérales du corps qu'on trouve les deux principaux troncs du système trachéen; ils apparaissent sous la forme de tubes d'un blanc argenté et légèrement ondulés, qui s'étendent depuis la tête jusqu'à l'origine du dernier segment ventral; chaque ondulation, qui correspond à un anneau est un peu renflée vers sa partie antérieure, et c'est du sommet de ce renflement ou de son extrémité antérieure que partent les ramifications qui se répandent dans toutes les parties du corps, et les rameaux qui communiquent directement avec les orifices extérieurs ou stygmates.

"Un sac pneumatique oblong ou plutôt fusiforme, dont l'origine est au point où naissent les ramifications, et qui s'étend parallélement au tronc principal, accompagne chaque ondulation; ces sacs au nombre de six de chaque côté, sont situés sur le côté interne de chaque tronc; leur courbure en opposition avec celle des ondulations, donne à l'ensemble de chaque trachée l'apparence d'une chaîne à anneaux oblongs ou très allongés; de l'extrémité postérieure de chaque sac partent deux rameaux dont l'un se dirige du côté

[1] Loc. cit., p. 38. [2] Loc. cit., p. 48.

latéral du corps de l'insecte, en passant en dessous de la principale trachée."[1]

"Tel est l'aspect," he concludes, "sous lequel se présente le système tracheén des Podurelles," a term by which he denotes all the COLLEMBOLA.

He appears, therefore, to consider the description as applicable to the whole group; and his statement has been so understood by succeeding writers, as, for instance, by Von Siebold,[2] and Gervais.[3]

I have not had an opportunity of examining *A. similata*, the species which he appears to have principally studied with reference to the respiratory organs, and cannot, therefore, call in question the correctness of Nicolet's description as regards that species, but his statements certainly do not apply to the *Poduridæ* generally, in none of which do I believe that any such system exists.

In this view I am confirmed by Meinert, who says, "I look upon the statements of Nicolet and of Von Olfers as entirely erroneous, and so far I agree with Lubbock."

Smynthurus, on the contrary, has a well-developed system of tracheæ (Pl. LXII, figs. 8 and 9). There are, however, only two large spiracles; at least I was unable to see any others; and all the larger tracheæ, even those in the posterior part of the body, seemed to me to be traceable up to them. It is very unusual for an articulate animal to have only two spiracles; and their position is still more extraordinary, for they open on the underside of the head, immediately below the antennæ. I know no insect which has spiracles either in the head or between it and the prothorax, and Burmeister ('Handbook of Entomology,' p. 165) even goes so far as to state that none are ever so situated. It appears, however

[1] Nicolet, 'Recherches p. s. à l'Histoire des Podurelles,' p. 49.
[2] 'Anatomy of the Invertebrata,' translated by Burnett, p. 438; and also 'Lehrbuch der vergleichenden Anatomie,' p. 620.
[3] 'Insectes Aptères,' vol. iii, p. 385.

(see Pagenstecher, 'Beiträge zur Anatomie der Milben'), that, though in most mites the tracheal orifices are situated at the base of the legs, yet in *Trombidium holosericeum* the spiracles are two in number, and, as in *Smynthurus*, are situated at the lower side of the head, though not exactly in the same place, since in this species they open on the inner side of the basis of the mandibles.

Close to the spiracles the tracheæ break up into a great number of thin branches, which supply the head without much more subdivision. There is also a very large trunk, which almost immediately divides into two branches, the smaller one of which soon divides again and supplies the anterior region of the thorax, while the other gives off branches to the posterior legs and the abdominal organs. In the manner of subdivision the tracheæ of *Smynthurus* differ from those of the true insects, and agree more closely with the Myriapoda and Arachnida, in the fact that they do not often give off branches or form tufts, but generally divide dichotomously, and run considerable distances without a separation.

I have noticed no respiratory movements, and the supply of oxygen is probably due, therefore, principally to that diffusive power of gases, the laws of which have been so well worked out by Dr. Graham, and even applied to the respiration of insects. "In the law of diffusion of gases," he says, "we have, therefore, a singular provision for the full and permanent inflation of the ultimate air-cells of the lungs. But it is in the respiration of insects that the operation of the law will be most distinctly perceived. The minute air-tubes accompanying the blood-vessels to every organ, and, like them, ramifying until they cease to be visible under the most powerful microscope, are kept distended during the most lively movements of the little animals, and the necessary gaseous circulation maintained wholly, we may presume, by the agency of diffusion." Though we must attribute some influence

to the respiratory movements exhibited by so many insects, the above explanation seems to me to throw much light on the question, which I have already treated at greater length in the 'Linnean Transactions' for 1860.

I should not have thought it necessary to allude again to the subject, but that Prof. Rathke, in a posthumous memoir "On the Respiratory Process in Insects" (see 'Ann. and Mag. of Nat. Hist.,' 3rd ser., vol. ix, p. 105), appears to have overlooked these facts, and thereby to have fallen into some errors. Thus he says, "From the absence of all such phenomena we might conclude that in the pupæ of the above-mentioned insects (Coleoptera and Hymenoptera) the tracheary respiration is entirely interrupted." And further on, "In any case it is certain that the respiration of pupæ can only be very weak." It has, I think, been sufficiently shown that the mere absence of respiratory movements does not necessarily involve such a conclusion.

While, however, in *Smynthurus Buskii* the mere presence of tracheæ is easily detected, difficult as it may be to ascertain their distribution, I have, to my great astonishment, been unable to detect a trace of them in the genus *Papirius*. Remembering that though the great Treviranus was unable to convince himself of the existence of tracheæ in *Lepisma*, they have since been discovered by Burmeister, and being only too well aware of the difficulties attending the dissection of these minute animals, I long attributed the apparent absence of tracheæ to my own unskilfulness; but this explanation is not, I think, tenable, and even if rudimentary tracheæ be hereafter discovered, I feel at least convinced that their arrangement and distribution will be found to differ altogether from those which characterise *Smynthurus*. It must be remembered that the air in the tracheæ of freshly killed insects glitters like threads of quicksilver; and however absurd it may sound, I consider the inside of an insect, with its beautiful and rich tracery of glittering tubules, to be

one of the loveliest objects in nature. In searching, therefore, for tracheæ, we are very much assisted by the presence of the air; and while in preserved specimens these organs are not easy to trace, at least towards their extremities, in fresh specimens they are generally very conspicuous.

Von Olfers repeats the statements of Nicolet, as regards *Achorutes* and the allied genera. His own observations were made on *Smynthurus oblongus*, *Tomocerus plumbeus*, and *Orchesella fastuosa*. In these he found the respiratory system formed on one plan. They have, he considers, two spiracles only, and these are situated on the inferior side of the thorax, close to the first pair of legs. From each spiracle start three principal trunks, one of which goes forwards, one upwards, and one backwards. The first two are immediately divided into a great number of branches, which are extremely narrow. The other passes to the middle line, lies close to the corresponding trachea of the other side, without, however, apparently uniting with it, and then also breaks up into a number of fine branchlets.

I have again examined *Smynthurus*, and can only confirm my previous statements. Von Olfers, without being acquainted with my memoir, agrees with me as

by *Smynthurus* are situated in the head, at the place where it is attached to the body.

As regards the other species, I differ still more from MM. Nicolet and Von Olfers. Having examined *Tomocerus plumbeus*, as well as species of *Achorutes*, *Lepidocyrtus*, *Isotoma*, and *Lipura*, I am satisfied that they do not possess any tracheal system answering to the descriptions either of Nicolet or of Von Olfers.

The *generative organs* (Pl. LXII, figs. 10, 11) are very simple, and similar in the two sexes; the testes and ovaries consisting of single tubes one on each side of the body. They commence near the anterior part of the abdomen, and posteriorly unite to form a vas deferens, which opens, on the ventral surface, immediately behind the base of the saltatory appendage. In the globular species the case is somewhat different. Owing to the delicacy of their membranous envelope, it is not easy to extract the ovary entire, but the best way is to make a section of the animal from the back, at the anterior part of the thorax, to the base of the spring; in this case the ovaries will generally be found uninjured, and may be separated from the other organs without very much difficulty. They consist of a single, short, and broad egg-tube on each side, and unite posteriorly to form a narrow vagina about ·003125″ in length. Having found it impossible to remove the skin in such a manner as to expose the ovaries *in situ*, and as the method above described destroys, of course, the natural position of the organs, I am unable to say much as to the usual position of the ovaries. They did not appear, however, to pass directly forwards, but seemed rather to curve round from the point of attachment to the vagina, so as to lie rather in the posterior part of the body.

M. Nicolet was unsuccessful in his search for the organs of generation. "Je l'ai déjà dit," he says, "les difficultés que l'extrême petitesse de ces insectes oppose à la dissection, rendent fort difficile l'étude de leur organisation intérieure, qui peut-être restera encore

longtemps inconnue; le hasard seul, en rendant un observateur témoin d'un accouplement, pourra faire découvrir leurs organes génitaux, mais un pareil hasard est difficile à prévoir." I quote this sentence as an excuse for the numerous details in the anatomy of *Smynthurus*, which I have left unascertained; but I may add that the small size of *Smynthurus* gave me less difficulty than its curious form and the extreme delicacy of its internal organs. By opening the animal, however, as above mentioned, I was able several times to make out the vagina above described, and also to trace it to the vulva, which is situated between the anus and the base of the saltatory apparatus, as is shown in Pls. LVII, LVIII A, and in Pl. LXIII, fig. 11.

The only accessory organs which I could find were two small, glandular, rounded bodies attached to the vagina close to the orifice. They were ·0055″ in width, and shaped like a kidney, with the convex side in front. On the posterior side of each, that is to say, near the vulva, is a dark brown rounded mass, about ·003″ in diameter. Beyond their relative position, I did not make out the relation which these organs bore to one another, or to the vagina.

The eggs are laid either singly, or in batches of from fifty to a hundred. In the cases observed by me

et aiguës à leur extrémité ; elles naissent chacune d'une espèce de bulbe, formé de deux renflements placés l'un au dessus de l'autre, dont le premier ou l'inférieur est hémisphérique, et le second ou le supérieur en disque arrondi ; c'est au centre de ce dernier qu'est attachée l'épine."

In some cases the eggs which are at first apparently smooth, after a few days will be found to be covered with long hairs.

Pl. LXII, fig. 10 represents the testis of *Papirius ornatus*. It consists of a simple tube on each side of the body (*a*), opening into a triangular reservoir with the base in front. The two posterior sides of the triangle are accompanied by a glandular accessory organ, containing a central cavity full of minute globules, the largest of which do not exceed ·000083″ in diameter, while the majority are much smaller. From the posterior angle of the reservoir a short and narrow vas deferens runs into the ductus ejactulatorius, which is also short and pyriform, opening, like the vulva, between the anus and the base of the saltatory apparatus.

The development of the spermatozoa proceeds as in *Obisium* (' Phil. Trans.,' 1861), The testis contains small cells, about ·00025″ in length, and collected into masses of various sizes, which have probably arisen within mother cells; their size does not appear to depend in any way on the stage of development of the Spermatozoa. The small cells which compose them are at first somewhat oval; gradually one end elongates, until at length they resemble in form the egg of a *Cynips*, consisting of a thread, with a small swelling at one end and a large oval body at the other; this, however, is not probably the mature form. The testis also contained numerous greenish, oval, or somewhat quadrate bodies, about ·0002″ in length, and exactly resembling the similar bodies which I found in the testes of *Chelifer* and *Obisium*, and which so curiously resemble the spermatozoa of *Polydesmus*.

There were also a number of larger spherical cells, from ·0005″ to ·001″ in diameter, and transparent, or containing only a few granules. These may, perhaps, be compared with the similar bodies found in the testis of Oniscus. The walls of the triangular reservoir are rather thick, and consist of nucleated cells. It contains the spermatozoa and the bright, greenish bodies, as well as some other globules, which resemble oil globules.

The walls of the accessory glands are also composed of thick cells. They are completely filled by the minute granules, which form an opaque mass. The ductus ejaculatorius has an apparently chitinous lining, which is strengthened, like the trachea and some other chitinous parts in Articulata, by transverse ribs, which, however, in this case are very delicate.

I have never found any eggs of Collembola sufficiently transparent to permit a satisfactory observation of the embryonic changes. Mr. Packard, however, has recently given us the following account of the embryology of Isotoma:

"The eggs of *Isotoma Walkerii* were found by Mr. C. A. Walker, at Chelsea, under the bark of an apple tree, on the 25th of April, 1870. They were either

figs. 1, 2) was the period of formation of the primitive band. I could not detect any eggs with blastodermic cells or a blastoderm fully formed. Fig. 2 represents the primitive band lying upon the outside of the yolk next to the chorion, and divided into the external tegumental layer (*t*) and the inner or muscular layer (*m*). The two ends of the primitive band meet at *a*, the band thinning out so as to be of an imperceptible thickness just before *a* (fig. 1), where there is a clear space and an infolding (*a*) of the primitive band, which seems to be the place of meeting of the anterior and posterior end of the germ. A little later the fold grows deeper (as at *b*, fig. 2), and *a* seems to indicate the rudiments of the cephalic lobes. The exact mode of origin of these lobes (Scheitelplatte of Zaddach) I did not observe.

"At a more advanced period of development the primitive band, now, more properly speaking, the primitive body-walls, is clearly defined, and is more homogeneous, the small cells previously scattered through its substance (as in fig. 2) having disappeared. This stage is signalised by the appearance of the primitive arthromeres or segments of the body (*protozonites* of Claparède). They originate just as they do in the *Phryganidæ*, according to Zaddach. They arise six in number (fig. 3), representing probably three cephalic and three thoracic segments (unless the fourth is the second maxillary arthromere, which more extended observations may prove to be the case). It will be noticed that they arise on the opposite side of the egg from the fold *a*, so that the cephalic lobes (*p l*) extend from *a* around to I. The central portion, or muscular layer of the egg, is now more homogeneous than before, the fat-globules having disappeared in the centre of the egg. Plate III, figs. 4 and 5, represent the germ farther advanced and the budding out of the appendages. The cephalic lobes are, as in fig. 5, quite clearly indicated, and the rudimentary appendages, in most cases, well shown.

At about this period the yolk sac is more circumscribed than before in the germ. Whether there is an internal division of the embryonal membrane (visceral membrane) which forms the yolk sac, as in *Agrion* and the *Hemiptera*, I was not able to determine. The outer layer ('amnion,' or parietal layer) which surrounds the embryo I did not at this stage observe, but as soon as the appendages are formed, as in fig. 8, the chorion bursts on slight pressure, and the embryonal membrane is readily detected, enveloping the embryo, like the 'larval skin' of many crustacea.

"At the period indicated by fig. 6 the dorsal walls (tergites) of the arthromeres are closed in and the rudiment of the spring (figs. 6 and 7, sp.) appears. It is liable to be mistaken for the antennæ (I), so large and well developed is it. It is evidently, in all respects, both in its origin from the under side of the penultimate segment of the abdomen and in its form, homologous with the cephalic and thoracic appendages. In fig. 7 the mandibles are just behind, and but little smaller than the antennæ (I), and in a vertical view (fig. 9) of the embryo when somewhat older, a pair of tubercles (II) are seen next to the rudimentary antennæ (I), which are probably the rudiments of the mandibles,

a more skilled observer would have made them out.

"Indeed, it is a most difficult thing to discover their rudiments in the adult; I failed, at the time these observations were made, to detect them, though since then I have succeeded in making out their structure and relation to the surrounding parts of the mouth.

"The cephalic lobes are very distinct, and posteriorly defined by a slightly marked suture from the postoral portion of the head. They are deeply cleft by the median line of the body. There are no indications of the basal tergites of the head, the segments to which they belong being not yet differentiated from the thorax.

"A later period (figs. 13, 13 *a*) is characterized by the differentiation of the head as a distinct region of the body, the posterior portion or postoral division of the head (including the mandibular and first maxillary arthromeres) uniting with the cephalic lobes to form the head, which is distinctly seen to move freely on the thorax. The ocelli are eight in number and arranged obliquely in pairs, being situated on an elongated, oval area just above the base of the antennæ. The two pairs of rudimentary postoral appendages, comprising the mandibles and maxillæ, are now greatly increased in size, both of much the same size and form, except that the hinder pair are divided by a slightly marked articulation which is not observable in the mandibles. The basal division of the maxilla probably represents the cardo and stipes together, the distal articulation representing the future palpus, galea, and lacinia. When seen in a front view we can better observe the relations of these organs to the labrum. This latter partially overlaps the mandibles on their inner edge, while the maxillæ are more external, though partially covered in front by the mandibles.

"The front of the head is so entirely different from what it is in the adult, that certain points demand our attention. It is evident that at this period the develop-

ment of the insect has gone on in all important particulars much as in other insects, especially the neuropterous *Mystacides* as described by Zaddach. The head is longer vertically than horizontally, the frontal, or clypeal region, is broad and greater in extent than the epicranio-occipital region. The antennæ are inserted high up on the head, next the ocelli, falling down over the clypeal region. The clypeus, however, is merged with the epicranium, and the usual suture between them does not appear distinctly in after life, though its place is seen in fig. 13 to be indicated by a slight indentation. The labrum is distinctly defined by a well-marked suture, and forms a squarish knob-like protuberance, and in size is quite large compared to the clypeus. From this time begins the process of degradation, when the insect assumes its thysanurous characters, which consist in an approach to the form of the myriapodous head. The front, or clypeal region, being reduced to a minimum, and the antennæ and eyes brought in closer proximity to the mouth than in any other insects.

"That other most essential thysanurous characteristic, the spring, is now fully formed. It arises as a thick tubercle from the sternite of the penultimate segment of the abdomen, and subdivides into a pair of

and *Coreus tristis*. At this period I could not detect any traces of a labium. The feet end in two claws, one being very minute and slender. Neither at this nor in the larval state could any traces of the tracheæ be observed, and I doubt whether they exist.

"The embryo, when about to hatch, throws off the eggshell and 'amnion' (or 'larva skin') in a few seconds. The larva is perfectly white, and is very active in its movements, running over the damp inner surface of the back. The larva (figs. 15, 15 *a*, spring; 16, 16 *a*, under side of the head, showing the mandibles and maxillæ, II, III; 17, the same seen ventrally) is a little over one hundreth of an inch in length, and differs from the adult in being shorter and thicker, with the spring very short and stout; while the head is much rounded, and the antennæ are stout and thick. In fact, the larva assumes the form of the lower genera of the family, such as *Achorutes* and *Lipura*, the adult more closely resembling *Degeeria*.

"The larva after moulting retains its early form, and is still white. It is then two and a half hundredths of an inch in length. After a second moult the body becomes purplish, translucent, and in form much more slender, resembling the adult.

"The eggs are laid and the young are hatched apparently within a period of from six to ten days."

The *nervous system* of *Tomocerus* consists of five ganglia, two of which, the supra- and infra-œsophageal, lie in the head, and are connected as usual by short commissures, between which the œsophagus passes.

Nicolet was unable to discover the nervous system in the linear COLLEMBOLA, while that of the globular species appeared to me much more difficult to make out. As described by Nicolet *Smynthurus* has, like *Tomocerus*, two ganglia in the head and three in the cephalothorax. The linear species have generally two ganglia in the thorax and at least one in the abdomen.

So far as I am aware, no naturalist had given any account of the *muscular system* of the COLLEMBOLA

before the publication of my papers in the 'Linnean Transactions.'[1]

With patience and spirits of wine, however, I have been able to make out the principal muscles pretty clearly.

I will describe those of *Smynthurus* and of *Tomocerus*, as representing respectively the globular and linear species. The largest muscles are those connected with the saltatorial apparatus. In *Smynthurus* these muscles (Pls. LVII, LVIII) are nine in number on each side of the body. The stoutest of all (Pls. LVII, LVIX) rises on the ventral side of the body, close to the middle line, and immediately in front of the reversible base of the saltatory apparatus. It passes upwards, expanding gradually, and is inserted sometimes by one, (Pl. LVIII, *b*) sometimes by two heads (Pl. LVII, *b*) on the side-wall of the body.

The second muscle, which is much smaller (*c d*), rises behind the first, and somewhat further from the middle line, being separated from the corresponding one on the other side by the central thickened part of the reversible base of the spring. It passes straight upwards, without altering in diameter, and is attached to the skin at *d*, behind, but on the same line as the preceding muscle.

The other four muscles belong to a different group altogether. The first of them (Pls. LVII, LVIII, *k l*) rises rather behind and outside the ventral attachment of the muscle *a b*. It then passes upwards and forwards and is inserted on the lateral wall of the body immediately above the ventral tube, and about halfway between it and the central line of the back.

The sixth muscle (*m n*) rises close to the preceding, between it and the first, and has the same general direction, but it is inserted higher up.

The seventh (*o p*) rises close to *c*, and consequently further back than either of the preceding, nor does it pass quite so far forward. It is attached not very far from *k*, but behind it.

The last of this group (Pl. LVIII, *q*) rises close to *n*, and is inserted below *n*.

Pl. LVII, *s t*. This is a small muscle which moves the second segment of the spring.

There are also several other small muscles in the posterior part of the abdomen, and belonging either to the terminal abdominal segment or to the rectum.

If a *Smynthurus* be examined after death, the tail will almost invariably be found extended as in Pl. LVII. If, moreover, we consider the mode in which the muscles just described act on the spring, we shall see that the most powerful of them tend to draw it forward, and not to extend it.

When, indeed, we see a *Smynthurus* leap, one is apt to be surprised at the muscular force which it must possess. It would appear, however, that its power of jumping arises from the elasticity of the spring, and not from direct muscular action. This is, doubtless, a more economical arrangement of force. It certainly may require less strength to pull the spring gradually forwards into position that it would to strike it against the ground with force enough to throw the *Smynthurus* so high up into the air. We see the difference very well in a crossbow; the muscular effort required to set the bow is much less than that which

would be necessary to project the arrow as far, if applied directly. One might suppose that though the force required to pull the spring forward might be much less than that necessary to move it backwards, still, as the spring is habitually carried with the points forward, there would be a constant strain in the one case, and only an occasional effort wanted in the other.

When, however, the spring points straight forwards, there is perhaps little strain on it; moreover, there is a little catch (Pls. LVII x, LVIII, fig. E), which is an organ homologous with the spring itself, but situated on one of the anterior segments; this passes between the two arms of the spring, and keeps them in place. It answers in fact to the catch in a crossbow, and as soon as it is drawn forwards, the muscle pulls the spring downwards, and its own elasticity does the rest.

A priori it might have been supposed that a position of rest was one of relaxation, in which the muscles were, so to say, at ease, but ready to spring up to attention in a moment if necessary. On the contrary, however, we find very often that a position of rest is a state of opposite tensions.

Take for instance our own case. The upright

I will take one more illustration from a very different part of the organized kingdom.

In most of the Orchids, as Mr. Darwin has shown us in his excellent work on that order of plants, the pollen from one flower is carried by insects to another; and if this is not done, the flower is not fertilized and the seed is not developed. Now, in our small Orchids, when an insect lights on the flower the sticky end of the pollinium adheres to the insect, and is thus carried away; in some of the large tropical Orchids, however, the part of the flower which insects visit is so far from the pollen-masses that a different arrangement is necessary. In *Catasetum*, for instance, there is a long sensitive process, or antenna, which hangs over the part on which insects alight, in such a manner that they can scarcely fail to touch it. Directly they do so, the flower throws its pollen-masses in the direction of the insect, and with such force that they will fly two or three feet. I have myself seen a flower, when its antenna was touched, throw the pollen-masses for about two feet, across a small table and to a window, on which they stuck.

This is not effected by muscular action; but the stalk on which the pollen-masses stand is bent round a protuberance, and held in position by a delicate membrane. When the sensitive antenna is touched this membrane gives way, and the elasticity of the pollen-stalk throws it forwards with much force, as just described.

The arrangement of the muscles of the ventral tube (Pls. LVII and LVIII) are extremely remarkable.

It is evident that the protrusion of the two filaments which can be projected from the end of the tube, as described in pp. 68, 69, could not be effected by muscular influence, excepting, indeed, by the indirect effect of those muscles which contract the cavity of the body, and thus, intensifying the general pressure, squeeze out, as it were, the two filaments.

For retraction, however, there are two muscles, *a' b* and *c' d'*. The first is attached to the extreme end of the filament (which in Pl. LXII, fig. 12, is represented as partially retracted); it passes all along the filament, and then close to the walls of the body, between them and four lateral muscles, which tend to keep it in place, and is then attached to the back, not far from *m*, and near the median line. The other muscle (*c' d'*) is attached to the middle of the filament; it runs parallel to the preceding, also passes between the four lateral muscles and the skin, and divides into two ends, which terminate near one another, and still close to the central line of the body. In Pls. LVII and LVIII the same parts are seen during retraction.

The presence of two muscles instead of one is necessary, owing to the length of the organ. It is evident that by itself the muscle *a b* would be able only partially to withdraw the filament, the length of the latter being greater than the distance from the insertion of the muscle to the end of the ventral tube, *e'*; the terminal portion of the filament would therefore still be left outside, if it were not for the muscle *c' d'*. Moreover, when the organ is about to be protruded, it is probable that the muscle *c' d'* relaxes first, and thus

generally represented the cut ends so as more clearly to show the relative positions.

If we commence the description of the abdominal muscular system from the dorsal line, we shall first meet with a straight wide muscle (Pl. LIX, 1), which lies on each side of the dorsal vessel, rising at the front margin of the segment, and passing directly backwards, through the segment and over the intersegmental membrane, is attached to the anterior margin of the following segment. In several cases I have found it continuous with the corresponding muscle of the preceding segment.

Pl. LX.—2. This muscle lies outside the preceding, and, therefore, in Pl. LIX is underneath, and hidden by it. In some specimens it is straight, in others, as in the one figured, it lies a little diagonally.

Pl. LX.—3 crosses under, or rather outside, No. 2. Like the two preceding, it rises at the anterior margin of the segment, and passes to that of the penultimate one.

Pl. LIX.—4. This muscle is one of those that move the tail. It rises close to, but at the side of the preceding, and passes diagonally backwards and downwards, curling round No. 5, which will be described next, and eventually reaching its posterior attachment at the dorsal side of the root of the tail.

Pl. LIX.—5. This muscle rises with a double head immediately below the preceding, and, passing backwards, twists as it were round it, and is also attached to the posterior margin of the following segment.

Pl. LIX.—6, 7. This is a transverse muscle. Its upper end is double, and is attached not far from, but rather in front of, the middle of the segment. It passes straight down, and is inserted into the central ventral piece.

Pl. LIX.—8 is inserted close to the anterior end of No. 5, and passes diagonally backwards and downwards, outside No. 6, and is attached to the lower side of the penultimate segment.

Pl. LX.—9 lies immediately outside No. 4, but is somewhat straighter, as it is not affected by No. 5.

Pl. LIX.—10 rises nearly in the centre of the side-wall, opposite the middle part of No. 6, and, passing backwards, is attached close to the posterior end of No. 4.

Pl. LX.—11 lies just outside No. 10, and has the same direction and attachments. In some specimens these two muscles seemed to form one only.

Pl. LX.—12. This powerful muscle is the principal extensor of the tail, and passes forwards along the ventral surface, through the antepenultimate segment, and is attached at the anterior end of the third abdominal segment.

These are the principal muscles of the fourth abdominal segment; I will now proceed to describe those of the third.

1. This muscle corresponds to the muscle No. 1, of the fourth segment, immediately in front of which it lies, and with which, in some specimens, as already mentioned, it even forms one continuous muscle. It generally, however, commences near the middle line of the back, on the side of the dorsal vessel, and directly in front of the anterior end of the corresponding

completely through it, to the anterior edge of the second, where it is inserted, partly below, and partly at the side of, the muscle No. 1 of that segment.

Pl. LIX.—6, 7. These two muscles correspond to those which I have indicated by the same numbers in the fourth abdominal segment. They rise, side by side, at the lateral edge of No. 5, and not very far from the anterior margin of the segment. They are largest at their dorsal extremity, and pass straight downwards.

Pls. LIX and LXI.—8. This powerful muscle rises at the anterior margin of the antepenultimate segment, at the side of No. 5, and passes downwards and forwards, dividing into two branches, which, at their lower and anterior extremity, are intimately connected with the neighbouring portions of Nos. 6 and 7, as well as of the muscle No. 16, which has not yet been described. The lower branch terminates in the third segment before arriving at its anterior margin; but the upper branch is longer, and penetrates into the next segment.

No. 9 rises below, and close to, No. 8. It has the same general course, but diverges somewhat, and ends at about the middle of the segment. It will be seen, from the figure, that the end lies under the muscle marked No. 16, and over that marked No. 15. It cannot, therefore, be directly attached to the skin in this position, because the muscle No. 15 comes exactly in the way. The true attachment of this end of the muscle, like that of Nos. 6 and 7, and the posterior branch of No. 8, with all of which it is closely connected, is not easy to make out. I believe, however, that a delicate membrane passes from its lower extremity, both backwards and forwards, over No. 15, and that, by thus acting on the centre of that membrane, the same effect is produced as if the muscle were actually attached to the skin at the point where it terminates.

Pl. LIX.—No. 10 rises under the posterior termina-

tions of Nos. 5 and 8, and passes forwards with a slight inclination downwards. It lies on the outer side of Nos. 6 and 7, and is attached, in the ordinary way, to the anterior margin of the segment.

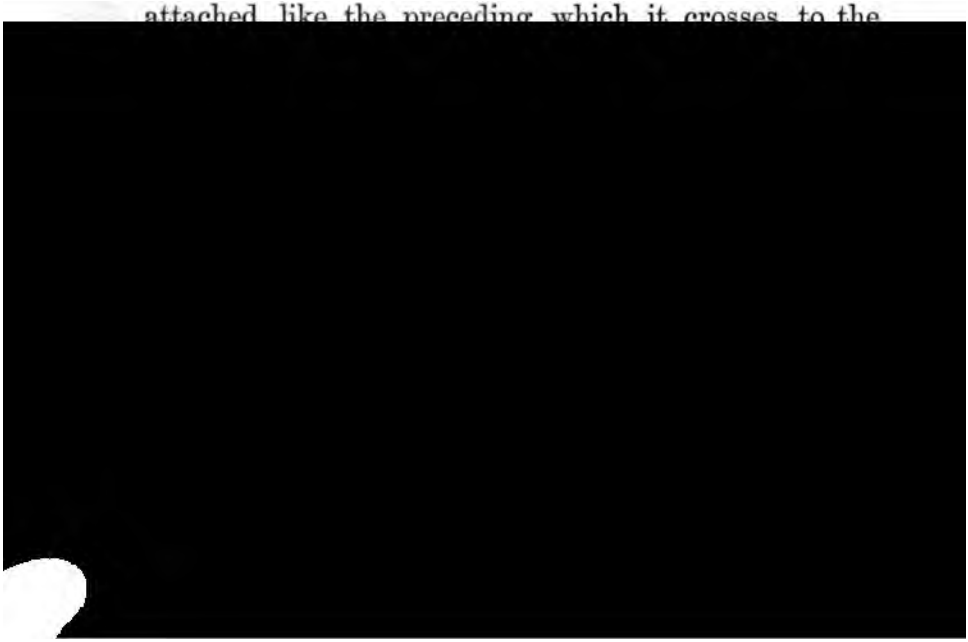
Pl. LX.—No. 11 lies outside the preceding. Some of the upper fibres did not, in the specimens I examined, reach so far as the margin of the segment.

Pls. LIX and LXI.—No. 12. This muscle, which belongs partly to this segment and partly to the antepenultimate, has already been described.

Pls. LX and LXI.—No. 13. This powerful muscle rises by a double head. One portion lies under No. 12, which is cut away at that part in Pl. LX in order to show No. 13; the other and larger portion is attached by a broad base to the gently curved arch, which here runs along the segment. Both branches soon unite, and pass straight forward completely through this segment, to the anterior margin of the second.

Pls. LX and LXI.—No. 14. This and the following are short, but powerful, transverse muscles. The present one rises under No. 13, but extends somewhat in front of it, and passes downwards and a little forwards to the ventral part of the segment.

Pls. LIX, LX, and LXI.—No. 15. This muscle is attached like the preceding, which it crosses, to the



than in the preceding. In several cases I even found Nos. 1, 2, 3, and 4 entirely deficient. No. 5, on the contrary, seems to be always present. There are, indeed, two muscles marked thus. The one rises in the third abdominal segment, as I have already mentioned, and passes forwards, dividing into two heads, which are attached to the anterior margin of this segment. The other, which corresponds with it, rises at the posterior end of this segment, at the edge of the muscle just described, and, passing through the present segment, is attached to the anterior margin of the first abdominal segment.

COLLEMBOLA.

Smynthuridæ, *Lubbock.*

Body globular. Antennæ 4-jointed; terminal segment long; ringed. Saltatory appendage composed of a basal portion and two arms. Tracheæ well developed.

Smynthurus, *Latreille.*

Plate LV, figs. 1—4.

Antennæ 4-jointed; no dorsal tubercles.

Smynthurus viridis.

Podura viridis, Linn. Faun. Suec.
La Podure verte aux yeux noirs, Geoffroy. Ins. Env. Paris.
Podura viridis, Linnæus. Sys. Naturæ.
— — Schrank. Enum. Ins. Aus.
— — Fabricius. Ent. Sys.

Geoffroy's description of this insect is still quite sufficient: "*P.* viridis, oculis nigris, capite flavescente, antennis in medio fractis."

The antennæ have the basal segments pale green, the terminal one reddish. The segments increase in length from the base to the apex. The basal one is ·004 of an inch in length, and ·003 in breadth; the second is ·008 in length, the third ·013, and the fourth ·027. The segments do not taper, though each is a little narrower than the preceding. The terminal segment has about twenty whorls of hairs. The mandibles are of the usual form; one of them, however, is somewhat characteristic, from having the penultimate tooth unusually projecting. The maxillæ resemble those of *S. fuscus* ('Linn. Trans.,' vol. xxiii, pl. xlv, fig 6). The feet resemble those of *P. cursor;* there are no tenent hairs. The spring is simple in form (Pl. LXIII, fig. 1). It has no tenent hairs, and the terminal lamellæ are without teeth; the hairs are simple, and shaped like a lady's riding-whip, but rather rough.

Smynthurus fuscus, De Geer.

Podura globosa fusca, Linn. Fauna Suec.
— — De Geer. Kongl. Swensk. Wet. Ac. 1743.
La podure brune ronde, De Geer. Gesch. d. Ins.
— *brune enfumée*, Geoffrey. Ins. Env. Paris.
Podura atra, Linn. Syst. Nat.
— — Schrank. Enum. Ins. Austr.
— — Fabricius. Ent. Syst.
— *signata*, „ „ „
— *atra*, Muller. Zool. Dan. Prod.
Smynthurus fuscus, Latreille. Gen. Crust. et Ins.
— *signatus*, „ „ „
— — Lac. Boisd. Faun. Ent. Env. Paris.
— *fuscus*, „ „ „
— *ater*, „ „ „
— *fuscus*, Burmeister. Handb. d. Ent.
— *ater*, Templeton. Trans. Ent. Soc., vol. i.
— *signatus*, Lucas. Hist. Nat. Amim. Art.
— *fuscus*, „ „ „
— *ater*, „ „ „
— *fuscus*, Bourlet. Mem. Soc. Roy. Lille, 1839.
— — „ „ „ Douai, 1842.

Smynthurus signatus, Nic. Mem. Soc. Helv. 1842.
— — Gervais. Suites à Buffon, Aptéres.
— *ater*, „ „ „
— *Buskii*, Lubbock. Trans. Linn. Soc., vol. xxiii.
— *signatus*, Porath. Of. af. k. Vet.-Akad. Forhandlingar, 1869.

Podura fusca, globosa, nitida, antennis longis, articulis plurimis.

Plate II.

Sweden, Switzerland, Germany, France, England.

Length ·125 of an inch; June to November.

Common in Kent, on pieces of wood and bark in damp situations.

They feed principally on the spores and first shoots of fungi. Many specimens were infested by a small mite, which adhered to the underside of the body, and was sometimes present in considerable numbers.

The hairs, which cover the head as well as the body, stand at a distance of about ·0047 of an inch from one another. They are gently curved, about ·0075″ in length, and roughened with small asperities or projections. The larger hairs on the antennæ are of the same size and structure, while those on the legs are smoother. The eyes, as in all the species of the genus, are eight in number on each side. The anterior five are arranged in a quincunx, which, however, is not quite regular one of the posterior, pair being a little too far back; the other three form a triangle. This arrangement agrees with that figured by M. Nicolet as characteristic of the genus (l. c., pl. ii, fig. 26); but in the present species the eyes are rather nearer together than in his figure, and agree even more closely with his representation of those of *Lepidocyrtus*, especially as in that genus he makes the eyes tolerably uniform in size; whereas in Smynthurus he represents the central eye of the quincunx as being much smaller than the others, which is not the case in this species. The antennæ are ·0475″ in length, of which the terminal many-jointed portion forms nearly one half. The basal segment is cylindrical and

quite short, being ·004″ in breadth, and ·005″ in length. The two following segments are of nearly equal size, being each about ·012″ in length, and 002″ in breadth.

On the whole they are cylindrical, but their outline, and especially that of the third, is somewhat knobby. They bear a few scattered bristles, resembling those on the head and body, and also a few smaller hairs near their apices. The terminal portion of the antenna resembles a necklace of beads welded together, and gradually diminishes in size at the tip, though, for the greater part of its length, it has a diameter across the beads of ·0015″. At each projection is a whorl of small hairs, and at the apex are a few rod-like hairs, resembling those found on the antennæ of so many insects and Crustacea, and which are doubtless organs of sensation, though I was unable, from their minute size, to ascertain their structure in a satisfactory manner.

The labrum is a simple, entire, quadrate, horny lobe, somewhat broader at the base than at the apex, with a few scattered hairs, and a row of teeth at a little distance from the free border, those on each side being parallel, and opposite to those of the other side; so that they all point inwards. The mandibles are rather small, and differ somewhat from one another, though they agree in general outline. The basal part is long and somewhat cylindrical, with a large gaping orifice, through which the muscles pass into the head. The whole organ is about ·03″ in length; at a distance of about ·02″ from the base is a raised molar surface which is covered with minute, rather blunt teeth, and, in conjunction with the corresponding portion of the opposite mandible, evidently serves the function of mastication. The terminal incisive portion is dissimilar in the two mandibles; the one has six teeth, the other only three, which fit into the intervals of the first. This part of the mandible diminishes rapidly in thickness towards the tip; the dorsal line, however, is continued throughout in the

same direction, though with three gentle curves resembling in outline, though less abrupt than, those of a bow or a reversed S. The front line of the mandible, on the contrary, makes a sudden change of direction at the beginning of the molar portion, so that the terminal part of the mandible seems to lie in a different plane from that of its basal part. The maxillæ are a little shorter than the mandibles. The width varies, being smallest towards the upper end and greatest towards the middle. The upper extremity is terminated by a somewhat complicated system of teeth. First, there are three strong curved teeth, the outer one being like the largest, and the inner one the smallest. In addition to these are two lamellæ, whose inner edges are beset with a row of minute sharp projections. Lastly, there is a large central, somewhat fan-shaped lobe, the central part of which bears some fine hairs on the margin. All these parts appear to have some power of independent movement. The body of the maxilla is strengthened by a chitinous framework; down each side runs a strong rib, while the two are connected at the centre by a transverse piece, which is also continued on the inner side a little way beyond the rib, and curves at the same time so as partly to surround the softer parts.

The two lateral ribs converge to meet one another at the base as at the apex. At the former, however, they enclose a space which has the form of an acute triangle, while at the basal end they curve round to meet one another. At the base the chitine is rounded off on the outer side, but is produced into a sharp point on the inner edge. The palpi are short, 1-jointed, rounded but not tapering at the free end, and with two longish setæ and one or two minute hairs, none of them, however, attached at the apex. The second pair of maxillæ are membranous and delicate. Their form is somewhat difficult to describe. At the extremity are two teeth of unequal size; on the basal side of these are three more or less projecting lobes;

and then follow a number of small teeth, which end at a point where the two maxillæ converge towards the middle line so as to touch one another. The under lip is stronger, and consists of two somewhat quadrate lobes. The feet of *Smynthurus* are very peculiar, and differ in the different species. Nicolet has given two figures of a foot, seen from different sides; but neither of them agrees altogether with any of those examined by me. In my specimens (Pl. LXV, fig. 3, the tarsus was very short, and bore two peculiar appendages. On the outer side was an elliptic, elongated claw, transparent above, terminating in a spine, and bearing also one large tooth and three smaller ones on its underside. On the underside of the tarsus is a second claw, smaller and more slender than the first. At its free end it is produced into two processes and a small spine; the shorter process reaches about as far as the free end of the other organ, and is like a spine in form, though apparently not so stiff; the second process is somewhat longer, and whip-like.

The anterior legs are the shortest, and the posterior the longest, the middle pair being intermediate in size as well as in position. The relative proportions of the segments, as well as the structure of the foot, are the same in all three pairs. The tarsus is very short; the tibia is much the longest segment. The coxa, trochanter, and femur diminish in diameter, and increase in length. At the attachment of the leg are one or two deep folds, which, however, are not, I think, to be considered as indicating true segments; and we may, therefore, consider the segments as being five in number. The legs are regularly, but not very densely, clothed with hairs.

The spring consists, as in all *Smynthuridæ*, of a basal portion and a pair of 2-jointed arms (Pl. LXIII, fig. 5). The basal segment of the arms tapers slightly; it bears a number of short and simple, as well as three tenent, hairs. The terminal lamella is oval, without hairs, but with a row of minute teeth

on its inner margin. At the base of the spring are two scimitar shaped organs (Pl. LXIII, fig. 12), which appear to be hairs specially modified, and of unusual size. They are about ·008 of an inch in length, and .001 in breadth. The apical half of the inner margin and a small part of the outer edge are roughened by irregular teeth; which, however, are so unsymmetrical as rather to suggest the idea of the border being fretted by use. The two scimitars often differed considerably in the extent to which they were thus affected.

I have been much puzzled about the synonymy of this and the two following species, and in allotting the names used by the early writers have been at length compelled to act on two considerations—viz., firstly, that the COLLEMBOLA in Scandinavia, Germany, Switzerland, and France, are, for the most part, the same as those of England; and secondly, that the earlier writers probably had before them those species which were most conspicuous, either from size or abundance.

Thus of the old genus *Smynthurus* we have in this country four large and common species; viz., *S. fuscus*, *S. viridis*, *Papirius fuscus*, and *P. ornatus*. Now about the first there can fortunately be no doubt; *Smynthurus viridis* is undeniably the *P. viridis* of earlier writers.

S. fuscus is evidently the species examined by De Geer, and corresponds sufficiently with the species described under the names placed at the head of this section. Moreover, Mr. Tullberg has been so kind as to send me some specimens of this species from Sweden, proving that it is an inhabitant of that country. The specimens, indeed, which I first met with and described under the name of *S. Buskii* differ in several points, but the examination of a large number of specimens has convinced me that our English species, in some cases, corresponds pretty well with the short descriptions of Linneus, Geoffroy, and

other early authors. Our brown *Smynthuri* appear to form one species only.

At first I was disposed to think that Geoffroy's *P. fusca* was only a variety of his *P. fusco nigra.* Some specimens of *Papirius fuscus*, however, agree in colour pretty well with his description, and he may, perhaps, have thought it not worth while to mention the difference in the antennæ. Several of the early writers evidently had two brown *Smynthuri* under their eyes, and, as already mentioned, we have, I think, in this country only one large brown species belonging to the true genus *Smynthurus.* On the other hand, *P. fuscus* varies in colour from soot colour to brown and purple. It is also very common, and unlikely therefore to have been overlooked.

Moreover, Geoffroy describes his *P. fusco nigra* as "lisse," and as possessing "trois ou quatres taches irréguliéres, de couleur de rouille ou de fauve," while of *P. fusca* he says it is "toute de couleur brune" and "nullement brillante ni luisante." Now *S. fuscus* is smooth and somewhat shining, and is marked with paler patches; while *Papirius fuscus* is uniform in colour and its surface is not smooth and shining, but velvety.

Under these circumstances I propose to abandon my name of *S. Buskii*, and to describe the species under the name of *P. fuscus.*

Our fourth large and common species is *P. ornatus.* It was apparently unknown to Geoffroy, Linnæus, and Schrank. Nor is the *S. signatus* of Fabricius, which is the *P. fusco nigra* of Geoffroy and the *P. atra* of Linnæus.

Smynthurus aquaticus, Bourlet.

Smynthurus aquaticus, Bourlet. Mem. Soc. Roy. Douai, 1842.
— — Gervais. His. Ins. Aptéres.
— — Nicolet. Ann. Soc. Ent. France, 1847.

Bourlet's description of this species is as follows: Blanc plus ou moins teinté de jaunâtre; abdomen

ovoïde ; une tache noire, triangulaire sur le front : dos vert bleuâtre ; dernier article des filets caudaux, court, ovalaire ; tubercules sous-abdominaux très saillants. Long $\frac{2}{3}$ ou 1 millim. Sur les plantes aquatiques.

I have also found this species on the surface of ponds in Kent.

Smynthurus luteus, Lubbock.

Smynthurus luteus, Lubbock. Trans. Linn. Soc., 1867.

Plate III.

Yellow; eyes on a black patch; apical portion of antennæ violet.

The females, which are decidedly larger than the males, are about $\frac{1}{33}$ of an inch in length. Very common, among grass, from May to July.

In colour and in habits this species closely resembles the *S. lupulinæ*, of Bourlet; the eyes, however, are situated on a black patch. My *S. aureus* agrees with *S. luteus* in the possession of the black patch, but differs in the form of the caudal lamellæ, of the feet, and of the antennæ.

The four segments of the antennæ increase in length

teeth are four and five in number; those of the male and female are alike.

The *claws* are simple; the inner one is small; there are two tenent hairs on the upperside; and the inner claw, which is elongated, appears to terminate in a small globular expansion, which has probably the same function. The feet are alike in both sexes.

Caudal appendage (Pl. LXIII, fig. 7). The basal segment tapers slightly; it bears scattered setæ, but no tenent hairs. The terminal lamellæ are elliptical, without setæ or teeth. At the end of the abdomen are two setæ much stronger than the rest. The caudal appendage of the male resembles that of the female.

Some specimens have on each side two longitudinal bands of rather darker yellow. These, I believe, only form a variety. These specimens have three dark spots on each side in the paler portion; each of these bears a hair.

It is very amusing to see these little creatures coquetting together. The male, which is much smaller than the female, runs round her, and they butt one another, standing face to face, and moving backwards and forwards like two playful lambs. Then the female pretends to run away and the male runs after her, with a queer appearance of anger; gets in front and stands facing her again; then she turns coyly round, but he, quicker and more active, scuttles round too, and seems to whip her with his antennæ; then for a bit they stand face to face, play with their antennæ, and seem to be all in all to one another.

Smynthurus pallipes, Bourlet.

Smynthurus pallipes, Bourlet. Mem. Soc. Roy. Douai, 1842.
— — Gervais. His. Ins. Aptères, vol. iii.
— — Nicolet. Ann. Soc. Ent. France, 1847.

Plate IV.

Purple; antennæ, legs and hairs pale yellow; eyes

on a black patch; spring white. Abdomen with a re-entering angle and scattered pale hairs.

France, Kent, among grass. Common, May to July. Length, ·035 of an inch.

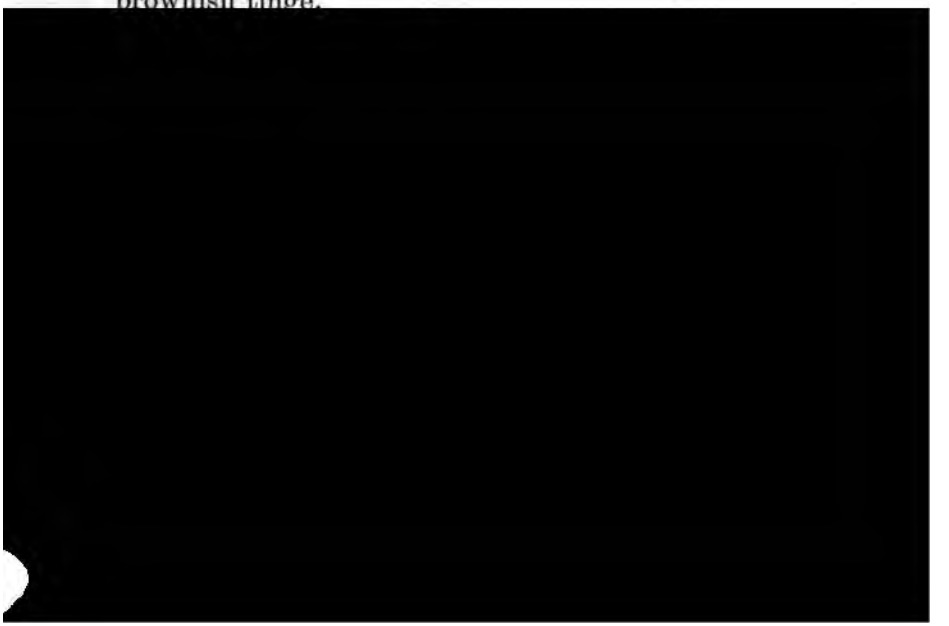
One mandible has five well-marked teeth; the other can hardly be said to have any at all. The feet much resemble those of *S. luteus;* there are two tenent hairs above, and one on the underside. The larger claw is simple, the lesser one very small. The saltatory appendage also (Pl. LXIII, fig. 4) much resembles that of *S. luteus.*

Smynthurus Bourletii, Gervais.

***Smynthurus Bourletii*, Gervais. His. Ins. Aptères, iii.**

Plate V.

Dark purple and yellow. The purple forms two broad, irregular bands with broken edges running along the side of the body; there are two yellow patches on the head between the black eye-patches, separated by a central band of dark purple, and uniting behind. The spring, legs, and underside of body are yellow, the two terminal segments of the antennæ with a brownish tinge.



extremity, and very finely serrated on the inner margin.

There is no other species with which this can be confounded.

Smynthurus niger, Lubbock.

Smynthurus niger, Lubbock. Trans. Linn. Soc., 1867.

Plate VI.

Blueish black; feet, terminal segment of spring, and a spot at the front inner corner of each eye-patch pale. Hairs short, white, more or less in longitudinal rows.

Length, $\frac{1}{15}$ of an inch. Under boards in my kitchen-garden: Not common, solitary, August to December.

This ugly little species does not resemble any one yet described. It differs from *S. ater* of De Geer in the form of the spring, &c., and from *S. fuliginosus* of Nicolet in the absence of white patches on the body, and in having the head and antennæ black.

The terminal portion of the antennæ is not distinctly ringed, the position of the subsegments being, however, indicated by the whorls of hairs. The upper lip is naked and rounded; one mandible has five teeth, while in the other they are rudimentary. The feet have several tenent hairs. The large claw is simple, the smaller one is narrower in the anterior legs than in the posterior ones. The terminal lamellæ of the saltatory appendage (Pl. LXIII, fig. 3) are narrow and pointed. Both appear to have on the same side a row of fine teeth; in fact there are two rows on the under surface, which, being almost always thrown either to one side or the other, give the appearance of asymmetry.

Smynthurus aureus, Lubbock.

Smynthurus aureus, Lubbock. Trans. Linn. Soc., 1862, p. 589.

Plate VII.

Yellow, with black eyes. Antennæ 4-jointed; basal segment shortest, terminal segment longer than the other three. Under side of body pale; saltatory appendage white. Body with a few scattered hairs, which are longer and more numerous towards the posterior extremity.

Length, $\frac{1}{30}$th of an inch.

Under damp pieces of wood, and among decaying leaves.

Common from February to June.

The four segments of the antennæ increase in length progressively from the base to the apex, each being about twice as long as the preceding. The long apical segment has whorls of short hairs, but no distinct evidence of segmentation. The eyes are situated, at usual, on a black ground; and near the central line, a little in front of the antennæ, is a black double spot, which looks like the seat of two ocelli. At the same time I did not obtain by dissection any further evidence

The remaining species of *Smynthurus* have not yet been found in England.

Smynthurus oblongus, Nicolet.

Smynthurus oblongus, Nic. Mem. Soc. Helv., 1842.
— — Gervais. His. Ins. Aptères, vol. iii.
— *bilineatus*, Bourlet. Mem. Soc. Roy. Douai, 1842.
— — Gervais. His. Ins. Apt., vol. iii.

Corps ovoide, plus allongé que celui du précédent (*S. fuscus*), sans angles rentrant aux côtés de l'abdomen, d'un gris jaunâtre, légèrement lavé de brun en dessus, et couvert sur toute sa surface de poil gris, peu serrés et courts. Plaques oculaires noires, bordées de jaune pâle Une tache en lunule entre les yeux, et deux bandes irrégulières et obliques sur le corps, d'un blanc sale, quelquefois jaunâtre; ces deux bandes se réunissent par leurs extrémités postérieures, de manière à former à peu près un V. Des deux côtés et au milieu de chaque bande sont plusieurs taches et points noirs et brun rouge. Pattes plus pâles que le corps ainsi que les trois premiers articles des antennes; dernier article gris. Queue blanche.

Longueur 1½ millimètre. Dans les champs de pommes de terre et sur les plantes légumineuses. Très rare; trouvé au Sablon, près Neuchâtel.

The following is Bourlet's description of his species, which seems to me to be the same as Nicolet's *S. oblongus:*

"Corpore pallido, dorso fasciis duables longitudinalibus ferrugineis. 1½—2 mill. Corps ovalaire, d'un blanc pâle; tête oblongue; peu dilatée latéralement; antennes de la longueur du corps, en entier d'un rouge-ferrugineux, plus obscur vers l'extrémité, paraissant quelquefois coudées, au-dessus du deuxième comme au-dessus du troisième article; deux bandes maculaires dorsales d'un furrugineux-rougeâtre; s'étendant depuis les yeux jusqu'à l'extrémité de l'abdomen; des taches de la même couleur sur les côtés de ce dernier, sur la tête et sur le croupion; celui-ci long et menu; organe saltatoire

blanc, dernier article de ses filets grèle, filiforme; abdomen coupé obliquement de chaque côté de son extrémité et terminé en angle aigu au-dessus du croupion. Sur l'herbe des prairies."

France.

Smynthurus lupulinæ, Bourlet.

Smynthurus lupulinæ, Bourlet. Mem. Soc. Roy. Douai, 1842.
— — Gervais. His. Ins. Aptères.

"$\frac{1}{2}$—$\frac{3}{4}$ mill. Abdomen subglobulaux d'un jaune uniforme en dessus, quelquefois avec une légère teinte ferrugineuse; d'un jaune-blanchâtre en dessous; antennes, surtout le dernier article, d'un rouge-ferrugineux, pubescentes, de la longueur des trois quarts du corps; abdomen brusquement terminé par un croupion plus long que dans les autres espèces, et paraissant formé de deux anneaux; pattes, organe saltatoire et tube gastrique, blancs; article terminal des filets caudaux, petit et grêle; dessus de l'abdomen formant un angle au-dessus du croupion. Trés commun dans les prairies sur le Medicago lupulina. France."

Smynthurus fuliginosus, Nicolet

"Trouvée au bord du lac de Neuchâtel, sous une pierre."

Smynthurus Lusseri, Nicolet.

***Smynthurus lusseri*, Nic. Mem. Soc. Ent. France, 1847.**

"Corps d'un brun rougeâtre en dessus, plus pâle en dessous, varié de jaune et de brun foncé, un peu allongé, surtout vers la partie postérieure, et couvert de gros points enfoncés ronds, bruns, ou noirs. Du centre de chaque point part un poil pâle et assez long, ce qui rend cet insecte très velu. Tête également pointillée et velue, mais plus pâle que le corps. Yeux noirs. Protuberances interoculaires d'un blanc bleuâtre. Pattes, antennes et queue d'un blanc sale, velues et parsemées de quelques points noirs. Long. envir. 0·003.

"Cette espèce est très commune sous les pierres, dans les forêts qui avoisinent Altorf et les bords du lac de Lucerne."

Smynthurus punctatus, Lucas.

***Smynthurus punctatus*, Lucas. Expl. Sci. de l'Algérie.**

S. antennis capiteque rubris, abdomine nigro, rubro, maculato, supràque punctatissimo; pedibus furcâque flavescentibus.

Long. 1½ mill.

Algeria.

Smynthurus guttatus, Say.

***Smynthurus guttatus*, Say. Journ. Acad. Philadelphia, 1821.**
— — Lucas. His. Nat. Crus. Arach. et Myr.

Body, yellowish-white, with numerous reddish-brown irregular spots, disposed in bands; numerous sparse white hairs and two tubercles on each side of the middle, which are truncated at tip; beneath, white; antennæ, reddish-brown, hairy; *face*, maculated, a line of irre-

gular spots behind the eyes; *eyes*, black; *spring*, flesh coloured.

Length rather more than one twentieth of an inch.

Cabinet of the Academy.

Found under the bark of a long-leaved pine (*P. palustris*) in Georgia.

Smynthurus deformis, Nicolet.

Smynthurus deformis, Nicolet in Gay. Hist. de Chili.

Fuscus, subglobosus, villosus; abdominis lateribus fulvo maculatis; pedibus furcâque flavescente fusco annulatis.

Chili.

Smynthurus fulvipes, Nicolet.

Smynthurus fulvipes, Nicolet in Gay. Hist. de Chili.

Subglobosus, nitidus, niger; capite, pedibus, furcâque pallide fuscis.

Chili.

Smynthurus exiguus, Nicolet.

Smynthurus exiguus, Nicolet in Gay. Hist. de Chili.

DICYRTOMA, *Bourlet.*

Antennæ eight jointed. Two conspicuous dorsal tubercles.

Here would naturally follow Bourlet's genus *Dicyrtoma*, of which he has described two species, *D. atropurpurea* and *D. dorsimaculata*. These two agree so closely in form and colouring with my two species of *Papirius* that I cannot but suspect them to be the same. If so, however, Bourlet's generic characters must be erroneous, and I do not feel justified in taking for granted that such is the case.

Bourlet describes his genus *Dicyrtoma* as follows[1]:—"Antennis octoarticulatis, dorso tuberculis duobus. Les Dicyrtoma ont les antennes longues, composées de huit articles, dont cinq pour la partie qui précède le coude, et trois pour l'autre. La premiere partie a son premiere article gros et court, et les quatre suivants à peu près égaux, la partie au-dessus du coude se compose d'abord de deux et quelquefois de trois articles, puis d'une pièce formée d'un grand nombre de petits anneaux, comme dans le genre précédent; mais elle est un peu moins longue. Cette derniere pièce offre en outre, un peu au-dessous de son sommet, une petite excroissance latérale. L'abdomen porte de chaque coté, vers le milieu de sa partie dorsale, un tubercule, audevant duquel sont quelques lignes imprimées irrégulières. Le croupion est gros, court et dirigé en bas, le genre ne comprend que deux espèces."

These two species are—

Dicyrtoma dorsimaculata, Bourlet.

Dicyrtoma dorsimaculata, Bourlet. Mem. Soc. Roy. Douai, 1842, p. 61.
— — Gervais. His. Ins. Aptères.

"Corpore luteo-pallido, dorso posteriore macula nigra oblonga.

[1] Mem. Soc. Roy. Douai, 1842.

"1 mill. ½. Abdomen subglobuleux, d'un jaune pâle : une tache noire, oblongue, vers l'extrémité de l'abdomen, occupant le tiers environ de sa partie dorsale : abdomen, surtout la dilatation latérale, marqué d'un grand nombre de taches ferrugineuses : une ligne de la même couleur entre les antennes : celles-ci de la longueur des deux tiers du corps : pubescence rare et blanche. Cette espèce court avec beaucoup de vitesse. Dans les prairies aquatiques.

"Var. Corpore variis coloribus maculato.

"Tout le corps couvert de taches ferrugineuses, brunes et blanchâtres : dos verdâtre : une grande tache d'un ferrugineux rougeâtre de chaque côté de l'abdomen : tache noire de l'extrémité de celui-ci, petite, presque orbiculaire : croupion brun."

Dicyrtoma atropurpurea, Bourlet.

Dicyrtoma atropurpurea, Bourlet. Mem. Soc. Roy. Donai, 1842, p. 60.
— — Gervais. His. Ins. Aptéres.

"Corpore atro-purpureo, antennis longioribus.

"2 mill. ½. D'un rouge-brun uniforme : tête longue, moins comprimée d'avant en arrière que dans les autres

Dicyrtoma oraniensis, Lucas.

Dicyrtoma oraniensis, Lucas. Expl. Scie. de l'Algerie.

D. capite furco violaceo; primis quatuor articulis antennarum, pedibus caudâque flavescentibus; abdomine fusco immalculato; oculis nigris.
Long 1¼ mill.
Algeria.

Dicyrtoma cirtana, Lucas.

Dicyrtoma cirtana, Lucas. Expl. Sci. de l'Algerie.

D. antennis octo articulatis, primis quatuor articulis flavis, subsequentibus cinereis; capite rufo villoso; oculis nigris; abdomine cinerio, sparsim albo-piloso; pedibus albescente flavis; caudâ violaceâ.
Long 1¼ mill.
Algeria.

Dicyrtoma alveolus, Lucas.

Dicyrtoma alveolus, Lucas. Expl. Sci. de l'Algerie.

D. capite corporeque nigroviolaceis, hoc fulvo maculato; abdomine flavo tessellato; antennis pedibusque flavescentibus, nigro annulatis; caudâ violaceâ.
Long. 2 mill.
Algeria.

Dicyrtoma lucasii, Nicolet.

Dicyrtoma Lucasii, Nicolet. Mem. Soc. Ent. France, 1847.

" Corps oblong, subovalaire, rétréci, et un peu prolongé postérieurement: d'un beau jaune paille ainsi que la tête. Yeux noirs; protubérances interoculaires peu saillantes, légèrement plus pâles; point de taches sur la tête. Antennes d'un brun rouge uniforme. Pattes et queue blanchâtres, et légèrement teintées de rose tendre sur une partie de leur longeur. Tubercules dorsaux éloignés l'un de l'autre, et rapprochés des

bords latéraux de l'abdomen, dont les côtés, ainsi que le ventre, sont maculés de rouge tendre. Des poils blancs soyeux et assez longs sont disséminés sur toute la surface du corps, ainsi que sur les pattes, la queue et les antennes, où ils se trouvent plus abondants.

" Cette espèce diffère du Dicyrtoma dorsi-maculata de M. Bourlet par l'absence de taches sur la tête, et sur l'extrémité postérieure de l'abdomen, et par ses tubercules dorsaux, beaucoup plus éloignés entre eux."

France.

PAPIRIIDÆ, *Lubbock.*

Plate LV, figs. 5—8.

Body globular. Antennæ four-jointed, terminal segment short, with whorls of hairs. Saltatory appendage composed of a basal portion and two arms.

PAPIRIUS FUSCUS.

Podura fusca, non nitens, Geoffrey. Ins. Env. Paris.
Smynthurus fuscus, Lucas. His. Nat. Anim. Art.

segment is ·005″ in length; the second ·0225″; the third is a little longer than the second, and especially towards its apical end, which is slightly swollen, and resembles a knobby stick. The terminal segment is about as long as the basal, and is somewhat conical. The whole organ is covered with scattered hairs, which are particularly numerous on the distal half of the third, and on the apical, segment. On the latter they are arranged in whorls, giving the organ an appearance of being jointed, which, however, is not really the case. The mandibles much resemble those of *S. fuscus*; I found, however, in my specimens six apical teeth on one mandible, and only four on the other. The maxillæ also resemble those of the *S. fuscus*. The arrangement of the teeth is, however, a little different; and they appear to be rather more numerous. The palpus is simple, short, ·005″ in length by ·002″ in breadth, and rounded at the apex; it bears one long and two or three short hairs, not at the apex, but almost in the middle of its length, though rather nearer the free end. The organ is membranous, and in most parts transparent. The upper lip is about ·00416″ in width, and is quadrate in outline, with the corners rounded off. The free edge is roughened by minute teeth, which are largest towards the centre; on each side there is also a row of larger teeth, parallel with the anterior margin, and with the teeth pointing inwards. The organ is also provided with scattered hairs. The legs are longer in proportion, but at the same time thinner, than those of the *S. fuscus*. The proportions of the different legs are the same, the anterior being the smallest, and the second pair intermediate in size between that and the third pair. In the relative sizes of the different segments, also, this species agrees very closely with *Smynthurus fuscus*, the coxa being short, and the three following segments increasing in size almost in a geometrical ratio. The whole organ, except the tarsus, is clothed with scattered hairs, which, however, are most numerous on the tibia.

The tarsus itself is short and bare. The appendages of the tarsus are (Pl. LXV, figs. 2 and 3) manifestly arranged on the same type as in *S. fuscus*, though the details so far differ as to offer good specific characters. The outer spine (*a*) is not elliptic, but resembles in outline the blade of a clasp knife, and has two strong teeth on the under edge. The second or inner appendage (*b*) also presents well-marked differences. The basal portion bears a small spine, and in the first foot gradually contracts; while in those of the third pair there is a sudden diminution immediately beyond the basal spine. The tip of the filament appeared to me to be slightly swollen. In this character it presents much analogy with the so-called "tenent hairs" described by Mr. Tuffen West in the twenty-third volume of the 'Transactions of the Linnean Society;' see, for example, his figures of these hairs on the tarsus of *Ocypus olens* (Pl. XLII, fig. 24*i*), or those from *Mylabris cichoriæ* (Pl. XLII, fig. 29). In both these cases, however, the hairs are very numerous, and their combined action is, no doubt, sufficiently efficacious; but in this case, where we have only a single hair on each foot, its action must be very slight. On each side of the back is a dorsal tubercle. The spring (Pl. LVIII,

Papirius ornatus, Nicolet.

Smynthurus viridis, Temp. Trans. Ent. Soc., vol. i. 1834.
— *ornatus*. Nic. Mem. Soc. Helv., 1842.
— *Coulonii*, ...
— — Gervais. His. Ins. Aptéres, vol. iii.
Papirius Saundersii, Lubbock. Trans. Linn. Soc., 1862.
Smynthurus ornatus, Porath. Of. af k. Vetusk-Akad. Forhand., 1869.

Plate IX.

Body globular, without a re-entering angle. The great abdominal segment is produced backwards, so that the two terminal segments are not seen from above when the animal is in its natural position. The penultimate segment is small, and only distinguishable on the ventral side.

Variety a.—Head yellowish, with a tinge of green on the posterior part, more or less distinct brownish markings on the central line, and a curved patch of the same colour behind the antennæ; eye-disc, black. Back, greenish, mottled with brown; the size as well as the darkness of the markings vary in different specimens; but the fundamental pattern is generally the same, though the proportions of the parts may differ considerably. On each side of the median line on the anterior half of the abdomen is a more or less interrupted band; about the middle of the back (that is to say, at their lower extremity) these are joined on the outer side by a diagonal band, and the two on each side unite, then separate again, and pass outwards and backwards, soon, however, returning again to the middle line, and thus enclosing a more or less quadrate or circular space of the paler colour. In the middle line, and at the posterior end of the great abdominal segment or segments, is a marking, which is very characteristic. There is first of all a small dark square, immediately behind which are three oblongs of the same colour, and at the posterior end a dark band passing backwards. The pale spaces between the oblongs vary

in width, and sometimes are almost obliterated. The oblongs also vary in length, sometimes increasing gradually in length from the front one, like the steps of a pyramid, while at others the two last or all three are of equal length.

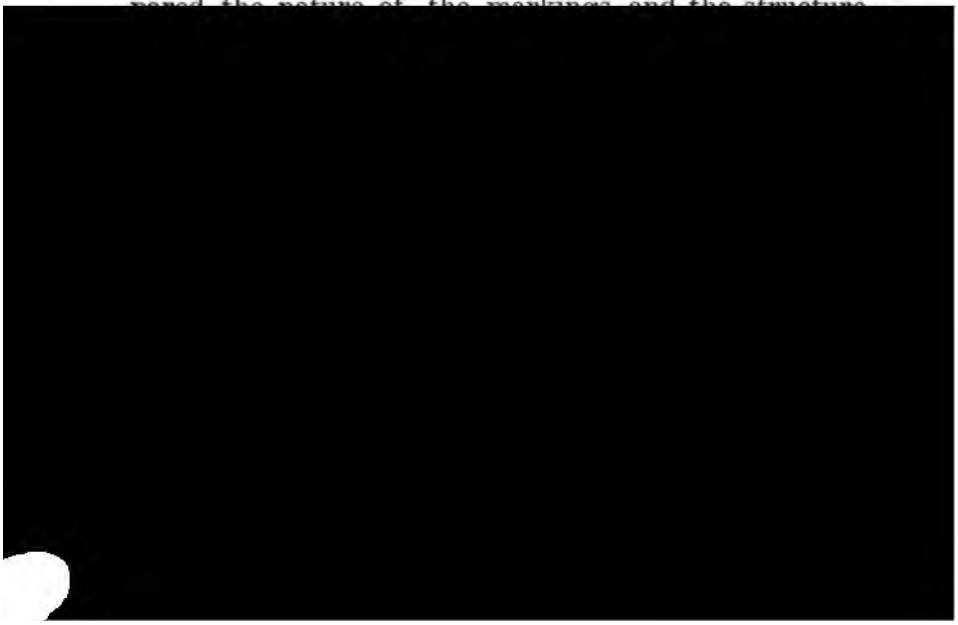
In different specimens I found every shade between brown and dirty olive-green, while in some the light ground preponderated over the darker markings, and in others the reverse was the case. Sometimes the darker parts were of a beautiful purple.

The sides of the body, and the two basal segments of the antennæ, are of the dark hue, whatever that may be, with, however, a few spots of lighter colour.

The two apical segments of the antennæ were purple in all my specimens, which struck me as a very curious fact, since I should have expected that the antennæ would have followed the law of colouring which prevailed on the other parts of the body.

The posterior segment of the abdomen, the spring, the whole underside of the body, and the legs, are pale; the latter with a tinge of red.

Variety b.—The dark parts are more extensive, and either very dark brown or purple. This variety is at first sight so different from the former that, until I com-



The antennæ closely resemble those of *P. fuscus*, the proportions of the different segments being, indeed, almost exactly the same.

The upper lip is rounded and entire. The margin is clothed with short hairs rather than teeth, and those at the middle are no longer than the lateral ones.

The mandibles have respectively six and five teeth; in other respects they, as well as the maxillæ and maxillary palpi, much resemble those of *P. fuscus*, as also do—

The second pair of maxillæ, which, however, have only one minute tooth. The margin is varied somewhat in different individuals, being occasionally almost straight, and in other cases more or less lobulated.

The tongue is rounded and bilobed, having a slight notch in the middle.

The lower lip is formed of two somewhat quadrate lobes, the outer angles of each lobe being rounded off, while the inner apical angle of each is slightly produced. The organ has several tufts of hair. The margins have no teeth.

The three pairs of legs, and the respective segments of which they are composed, agree closely with those of *P. fuscus*; but the foot though formed on the same type differs in its details.

Pl. LV, fig. 4, represents one of the anterior feet. The claw is stouter than in *P. fuscus*, and the lower angle is produced into a small claw. The lower appendage is rather thicker than in *P. fuscus*, and the filament, E, is somewhat shorter.

The small appendage attached to the ventral surface of the first abdominal segment is shaped somewhat like a pear, and attached by its larger extremity. It bears four or five short hairs. Attached to it is a second piece, also of a pyriform shape, but with the apex divided into two lobes. When the spring is turned forwards, the base ends close to this organ, exactly as described by M. Nicolet.

The basal part of the spring, that is to say, the part

measured from the fold which separates (if my suggestion is correct) the first from the second abdominal segment, is ·0125″ in length; the middle part is ·022″ in length, with a breadth of ·002″ at the base, and ·002″ at the extremity, while the terminal segment is ·0075″ in length, and ·00125″ in width, at the base. It tapers a little towards the extremity, and has from thirty to forty small teeth on its inner margin.

The distribution of the hairs resembles that of the preceding species.

The hairs on the posterior part of the abdomen are of two sorts, some being short and sword-shaped, while others (Pl. LXV, fig. 6) are longer and resemble a lady's riding-whip.

The males may be distinguished from the females, so far as my observations went, only by the presence of a small papilla on the ventral surface just in front of the anus.

Nicolet's figures of his *S. ornatus* and *S. Coulonii* represent them as possessing antennæ resembling those of *Smynthurus*, hence, I naturally at first considered my specimens as constituting a new species, which I proposed to dedicate to the eminent biologist Mr. W. W. Saunders. Having, however, satisfied myself that my

blancs, à l'extrémité de l'abdomen. Yeux noirs bordés de blanc au côté intérieur et separés par une ligne longitudinale, rouge. Antennes rougeâtres à base jaune très-pâle. Queue, pattes et dessous du corps, jaune pâle. Deux taches blanches de chaque côté en dessous du ventre."

Longueur : 1½ millimètre.

Sur les mousses vers la fin de l'automne ; très-rare ; trouvée à la roche de l'Ermitage, près de Neuchâtel. Cette espèce n'est peutêtre qu'une variété de l'espèce précédente.

Papirius nigromaculatus, Lubbock.

Smynthurus signatus, Temp. Trans. Ent. Soc., vol i.
Papirius nigromaculatus, Lubbock. Trans. Linn. Soc., 1862.

Plate X.

Yellow ; eyes, ocelli, and a patch on the posterior part of the back. Large specimens are a little mottled on the back with light brown, and on each side there is a pale band, which surrounds the black patch, and then passes forwards and outwards. Legs and belly pale. Antennæ a little darker, except at the base.

Length $\frac{1}{10}$ of an inch.

Found, in spring and summer, under dead pieces of wood in Kent. Common.

In the form of its different organs, this species much resembles *P. ornatus*. The two black spots, which I suppose to be ocelli, are more distinct.

The antennæ are very like those of that species. The mandibles have respectively five and six teeth.

The anterior legs and feet very closely resemble those of *P. ornatus*, and the posterior feet differ slightly, if at all. The filament (*c*), however, appeared to be shorter, and the inner claw had only one tooth on the outer margin. Still *P. ornatus*

itself varies in this respect, and one specimen of the present species had a second very minute tooth.

The saltatory appendage offers no special peculiarity.

Papirius polypodus, Linn.

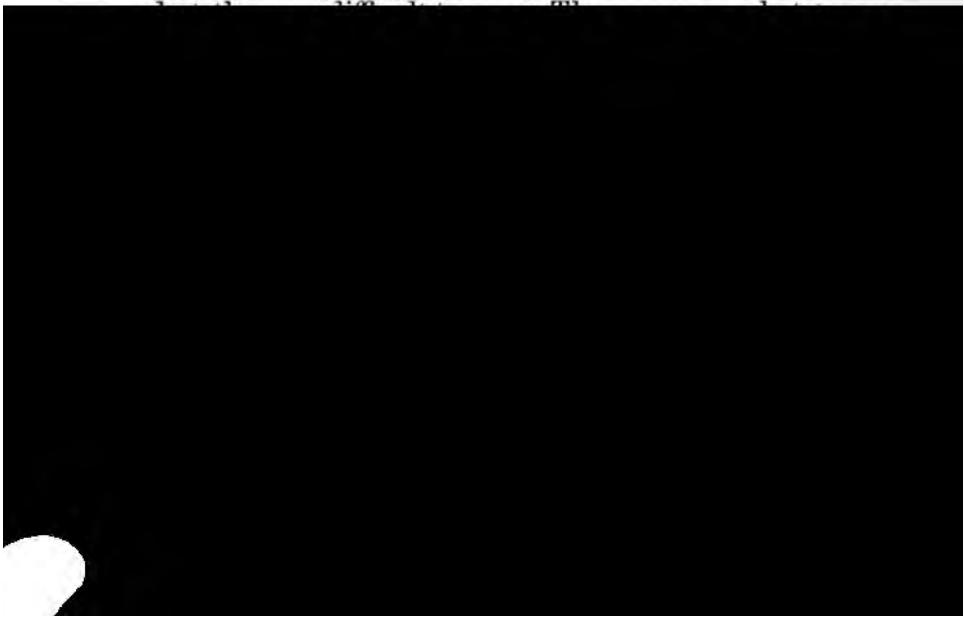
Podura atra, Linn. Faun. Suec.?
— *polypoda*, Linn. Syst. Nat.
— — Fabricius. Ent. Syst.
Smynthurus polypodus, Bois. & Lac. Faun. Ent. Env. Paris.
— — Burmeister. Hand. d. Ent.
— — Lucas. His. Nat. Anim. Art.

Plate XI.

Linnæus describes this species as follows:

"*Podura* subglobosa atra, antennis longitudine corporis apice albis," and places it between *P. viridis* and *P. atra*. Fabricius, Burmeister, and Lucas only copy this description. Latreille does not mention it. Nicolet and Bourlet do not appear to have found any species answering to Linnæus' description.

The English specimens, which I believe to represent this species, are violet rather than black. I have met with them sparingly, during the month of November;



Family 2. DEGEERIADÆ, *Lubbock.*

Body cylindrical. The appendages of the fifth abdominal segment developed into a saltatory apparatus, which consists of a basal portion and two arms.

ORCHESELLA, *Templeton.*

Segments of the abdomen unequal. Six eyes in each group. Antennæ 6-jointed, about as long as the body, which is without scales, but covered with hairs, the larger ones clubbed. Feet biunguiculate. Caudal appendage long.

The species of this genus are above the medium size, abundant, and prettily mottled. They are found under fallen boughs of trees, in moss, among decaying leaves, and in other similar situations. Numerous species have been described by various writers, and especially by Bourlet and Nicolet, but after having examined a very large number of specimens, I am satisfied that the greater number are mere varieties.

Orchesella cincta, Linn.

La Podure porte-anneau, Geoffroy. Ins. Env. Paris.
Podura cincta, Linn. Faun. Suec.
— — „ Sys. Nat.
— *vaga* „ „
— — Fabricius. Ent. Sys.
— *cincta* „ Kong. Dansk. Vid. Sels. Skr. 1783.
— — Latreille. Gen. Crus. et Insect.
— — Bois et Lac. Fauna Ent. Env. Paris.
Orchesella cincta, Temp. Trans. Ent. Soc., vol. i.
— *filicornis*, „ „ „ „
Podura cingula, „ „ „ „
Choreutes cingulatus, Burm. Handb. d. Entom.
Orchesella cincta, „ „ „
Heterotoma pulchricornis, Bourlet. Mem. Soc. Roy. Lille, 1839.
— *musci*, „ „ „ „
— *vaga*, „ „ „ „
— *septemguttata* „ „ „ „
— *quadripunctata* „ „ „ „

Heterotoma cincta, Bourlet. Mem. Soc. Roy. Lille, 1839.
— *livida* „ „ „ „
Podura variegata, Guer. u. Perch. Gen. d. Ins.
Orchesella sylvatica, Nicolet. Mem. Soc. Helv., 1842.
— *fastuosa*, „ „ „ „
— *bifasciata*, „ „ „ „
— *unifasciata*, „ „ „ „
Ætheocerus pulchricornis, Bourlet. Mem. Soc. Roy. Douai, 1842.
— *cinctus*, „ „ „ „
Orchesella filicornis, Lucas. His. Nat. des Crus. Ar. et Myr.
— *cincta*, „ „ „ „
— *succincta*, Guerin. Ex. des Pl. l'Icon. du Regne An. de Cuvier, p. 6.
— — Lucas. His. Nat. des Crus. Ar. et Myr.
Podura cincta, „ „ „ „
— *vaga* „ „ „ „
— *cingula*, „ „ „ „
Orchesella filicornis, Gervais. His. Ins. Aptéres.
— *cincta*, „ „ „
— *milanocephila*, „ „ „
— *fastuosa*, „ „ „
— *unifasciata*, „ „ „
— *bifasciata*, „ „ „
— *succincta*, „ „ „
Heterotoma livida, „ „ „
— *pulchricornis*, „ „ „
— *musci*, „ „ „
— *vaga*, „ „ „
— *septemguttata*, „ „
— *quadripunctata*, „ „
— *cincta*, „ „ „
Orchesella filicornis, Nicolet. Mem. Soc. Ent. France, 1847.
— *fastuosa*, „ „ „ „
— *cincta*, Nicolet. Mem. Soc. Ent. France, 1847.

second abdominal segment, two patches on the meso-thorax, and two spots on the posterior margin of the fourth abdominal segment are white; the two terminal segments of the antennæ are brown. The rest of the body is mottled, and specimens may be found of every hue between light reddish brown and deep black.

In the black specimens the dark band on the third abdominal segment ceases to be conspicuous, and the pale one on the second abdominal segment comes out by contrast; such specimens constitute the *Podura raga* of Linnæus and subsequent authors. On the other hand, in pale specimens the dark band on the third abdominal segment is the salient feature; and these specimens form Linnæus's *P. cincta*. This name seems to me the best of all those which have been given to the species, because in all cases one or other of the transverse abdominal bands is the distinctive characteristic of the species.

Norway, Sweden, Switzerland, France, England.

Length, ·25 of an inch.

Orchesella villosa, Geof.

Podura villosa, Geoffroy. Ins. Env. Paris.
— — Linn. Sys. Nat.
— — Schrank. En. Ins. Austriæ.
— — Sulz. His. Ins.
— — Fabricius. Ent. Syst.
— — Latreille. Gen. Crus. et Insect.
— — Lac. et Bois. Fauna. Ent. Env. Paris.
— — Dumeril. Cons. Gen.
Choreutes villosa, Burmeister. Handb. d. Entom.
Podura sylvatica, Muller. Zool. Dan. Prodr.
Heterotoma villosissima, Bourlet. Mem. Soc. Roy. Lille, 1839.
— *grisea*, „ „ „ „
Isotoma villosa, „ „ „ „
Orchesella villosa, Nic. Mem. Soc. Helv., 1842.
Æthecerus griseus, Bourlet. Mem. Soc. Roy. Douai, 1842.
Podura villosa, „ „ „ „
— — Lucas. His. Nat. Crus. Ar. et. Myr.
— *annulata* „ „ „ „
Orchesella villosa, Gervais. His. Int. Aptères.
— *histrio*, „ „ „
Isotoma villosa „ „ „

Heterotoma villosissima, Geryais. His. Int. Aptères.
— *grisea*, „ „ „
Orchesella villosa, Nicolet. Mem, Soc. Ent. France, 1847.
— *histrio* „ „ „ „
Isotoma villosa „ „ „ „
Orchesella pitosa, Lubbock. Trans. Linn. Soc., 1862.

Plates XV and XVI.

Yellowish-grey, sometimes with a tinge of green; the body mottled, and the legs annulated with brown or black. Basal segment of the antennæ pale; second, third, and fourth brown or black, but generally pale at the two extremities; the two terminal segments pale, tinged with brown. Eyes on a black patch. Head and thorax with numerous clubbed hairs; abdomen more sparingly covered.

Length, ·25 of an inch.

Sweden, France, Switzerland, England.

I have some doubts whether this species is the *O. villosa* of Nicolet, as the colouring of the legs and antennæ is altogether different. Nicolet also describes his species as having scales, which are "incolores, irrégulières et striées." Still, I have found our English species in Switzerland, where it seems common, but I have never met with any specimens in that country

shaped, processes, serrated on their inner margin. At the side of these are two other lobes: one of these is long, narrow, pointed, and generally lies, as it were, across the top of the organ; it is serrated at its free extremity on the inner edge. The other lobe is large, and ends in a tooth pointing inwards; the outer border is arched, the inner straight. It is, however, by no means easy to make out these different processes in a satisfactory manner.

The appendage which I regard as the palpus, is quadrate, but rounded off at the angles, and tapers slightly towards the apex. The apical margin is somewhat concave. The palpus has on one side a small process, which terminates in a stout bristle. At the base of the process is another stout seta, in addition to which the organ bears three smaller hairs.

The second pair of maxillæ are membranous, and have the apical margin excavated, with a tooth at the inner angle.

The eyes are arranged as usual in the genus, and do not differ much in size. The antenna, which is inserted just in front of the "quadrilateral," must somewhat obstruct the field of view.

The feet possess a tenent hair and two strong, though unequal, claws. The larger claw has a strong spine on the outer margin near the base, and two smaller ones on the inner margin, which are situated at almost equal distances from one another and from the two extremities. Near the tip is sometimes an indication of the third spine which we find more developed in the preceding species.

The small claw is lanceolate and simple. Near the base, however, and on the inner margin, is the rudiment of a tooth; but in many cases it is very difficult to perceive.

All the three legs are alike, so far as the constitution of the foot is concerned.

The caudal appendages end in a claw which is curved downwards, and has on the under surface a

strong tooth. To see this properly, however, the organ must be regarded from the side.

In this species I have found *Gregarinæ*. They were of two forms, either round or elliptic. The latter appeared to be generally, if not always, united in pairs.

The following species have not been met with in England.

Orchesella rufescens, Linn.

Podura rufescens, Linn. Sys. Nat. ?
Heterotoma flavescens, Bourlet. Mem. Soc. Roy. Lille, 1839.
Orchesella melanocephala, Nicolet. Mem. Soc. Helv., 1842.
Ætheocerus rufescens, Bourlet. Mem. Soc. Roy. Douai, 1842.
— *rubrofasciatus*, „ „ „ „
— *quinquefasciatus*, „ „ „ „
— *dimidiatus* „ „ „ „
Orchesella melanocephala, Gervais. Ins. Apt. vol. iii.
Heterotoma flavescens, „ „ „
Orchesella flavescens, Nicolet. Mem. Soc. France, 1847.
— *rubrofasciata*, „ „ „ „
— *quinquefasciata*, „ „ „ „
— *dimidiata*, „ „ „ „

Nicolet's description of this species is as follows:

" Corps conique à l'extrémité et peu fusiforme. Tête

milieu et trois petites taches jaunes obliques sur les côtés. Troisième, quatrième et cinquième segments comme le premier, avec les quatre bandes plus rapprochées des bords latéraux. Sixième segment d'un brun rouge très-foncé et presque noir vers sa partie antérieure, mais diminuant d'intensité et se résumant en trois bandes longitudinales sur un fond gris mélangé de jaune, vers son extrémité postérieure. Les deux derniers segments du corps sont trés-petits, et d'un gris jaunâtre, avec quelques taches couleur de rouille. Cuisses jaunes, à extrémité rougeâtre. Jambes grises. Dessous du corps et queue d'un blanc sale ou d'un gris jaunâtre très-pâle.

" Longueur 4 millimètres.

" En Mars et Avril, sous les mousses, dans les forêts de Chaumont, près de Neuchâtel, très commun ; vit solitaire."

I have myself found this species in the woods of Chaumont and elsewhere in Switzerland, where it is very common, but I have not yet met with it in England. It is flatter and more depressed than the two other species, and is marked with longitudinal bands. In some specimens the median band is much more distinct than in others, and these two varieties have been regarded as two species by Bourlet, under the names, *Æ. rubrofasciatus* and *Æ. quinquefasciatus*. Again, in different specimens the bands vary in tint from reddish-brown to black, the dark ones forming Bourlet's *Æ. dimidiatus*.

Orchesella chilensis, Nicolet.

Orchesella chilensis, Nicolet. Gay.
— — Ann. Soc. Ent. France, vol. v, p. 367.

" Lutea, thorace rufo vittato, lateribus fulvidis, abdomine nigro variegato, pedibus flavescente fusco annulatis."

Orchesella mauritanica, Lucas.

***Orchesella mauritanica*, Lucas. Expl. Sci. de l'Algérie.**

Pilosa, capite fusco variegato, vittis luteis in medio transversim ornato; antennis sæpius rubris, duobus pinnis articulis nigris, tertio brevi, albo; thorace ferrugineo, fusco nigroque variegato, supra albo quadrimaculato; abdomine fusco, antice albo fasciato, postice fulvomaculato; pedibus furcâque albescentibus.

This species does not appear to me to differ from the *O. cincta*. Lucas himself suggests that it is probably only a variety.

Orchesella luteola, Lucas.

***Orchesella luteola*, Lucas. Expl. Sci. de l'Algérie.**

O. elongata, flava, pilosa; capite immaculato, oculis magnis, nigris; thorace antice rotundato, lateribus subrectis, longitudinaliter ferrugineo bilineatis; abdomine oblongo ferrugineo maculato; antennis, pedibus furcâque pallide luteis.

Algeria.

This species does not seem to differ specifically from the *O. villosa* of Europe.

Tomocerus longicornis, Muller.

Podura longicornis, Muller. Zool. Dan. Prod., 1776.
— — O. Fabr. Kong Dansk. Vid. Sels. Skr., 1783.
Macrotoma longicornis, Bourl. Mem. Soc. Roy. Lille, 1839.
— *ferruginosa* „ „ „ „
Tomocerus plumbeus, Nicolet. Mem. Soc. Helv., 1842.
Macrotoma spiricornis, Bourl. Mem. Soc. Roy. Douai, 1842.
— *longicornis*, Gervais. His. Int. Aptères.
— *ferruginosa*. „ „ „
Tomocerus plumbeus, Nicolet. Mem. Soc. Ent. France, 1849.
Macrotoma plumbea, Lubbock. Linn. Trans., 1862.

Plates XVII and XVIII.

Colour, with scales, leaden; without them, yellow, with pale lateral markings on the mesothorax. Antennæ longer than the body, Anterior abdominal segment a little narrower than those on each side of it; fourth abdominal segment cylindrical, but more curved at the posterior margin than in Nicolet's figure. There is also a pale narrow line running down the back to the hinder end of the third abdominal segment. Legs hairy and scaly throughout, at least except the tarsus.

Length ·25 of an inch.

One of the mandibles has five teeth, the other four.

The three pairs of feet are very similar to one another, though in my specimens the extremity of the small claw seemed to be more elongated in the posterior foot than in the other two. The tarsus is provided with a single tenent hair and two unequal claws. The tenent hair is large and strong. The larger, outer claw has three equidistant spines on the under margin. The lesser claw has a very small spine on the outer margin.

The two branches of the caudal appendage have on their upper side, near the base, a row of about nine small, simple, black spines, the hindermost of which is affixed rather further from the side than the others. The largest spine is $\frac{2}{1000}$ths of an inch in length, the

diameter of the branch being at that place $\frac{7}{1000}$ths of an inch.

Norway, Sweden, Switzerland, France, England.

Tomocerus plumbeus, Linn.

Podura teres plumbea, Linn. Fauna Suec. ?
La Podura grise commune, Geoffroy. Ins. Env. Paris.
— *violette* „ „ „
Podura corpore teriti nigrocæruleo plumbeo, De Geer. Ges. d. Ins.
— *plumbea*, Linn. Sys. Nat.
— — Schrank. Ent. Ins. Austriæ.
— — Fabricius. Ent. Sys.
— — O. Fabricius. Fauna. Grænl.
— — Müller. Zool. Dan. Prod.
— — Latreille. Gen. Crus. et Ins.
— — Boisd. et Lac. Faun. Ent. Env. Paris.
— — Temp. Trans. Ent. Soc., vol. i.
— *gigas*, O. Fabr. Kong. Danske. Vid. Sels. Skr., 1783.
Choreutes plumbeus, Burm. Handb. d. Entom.
Macrotoma plumbea, Bourlet. Mem. Soc. Roy. Lille, 1839.
— — „ „ „ Douai, 1842.
Podura plumbea, Lucas. His. Nat. des Crus. Ar. et Myr.
Macrotoma plumbea, Gervais. His. Ins. Aptères.
— *minor*, Lubbock. Trans. Linn. Soc., 1862.
— *plumbea*, Porath. Of. af k. Veteusk.-Akad. Frok., 1869.

Like the preceding in general outline and colour, it is, however, smaller. The antennæ are shorter than the body, which, *without* the scales, is of a dull leaden

on each side of it. The mandibles have, respectively, four and five teeth. The processes at the end of the maxillæ are not exactly like those of *T. plumbea*.

The anterior feet have the usual tenent hair, and on the under side of the large claw, five or six small teeth; the lesser claw is lanceolate in form, but with the lower margin straighter than the upper one, and has a single, very minute tooth on the upper side. The second and third pairs of feet much resemble the first; but the small spine on the lesser claw of the third pair is rudimentary or altogether absent. On the basal part of the caudal appendage are, as in *T. plumbea*, nine black spines. In that species, however, they are simple and short, while in the present they are much longer; the four first form a somewhat curved line; the remaining five are arranged in a straight row, and have small processes at the side; the apical spine and the penultimate are the largest.

The form and arrangement of these spines, and the structure of the feet, satisfactorily distinguish this species from the preceding. If in *T. minor*, which is smaller than *T. plumbea*, these caudal spines had been smaller than in that species, and the spines on the feet had been less numerous, we might well have supposed that these differences depended on age, and were therefore of no value as specific characters. I was, indeed, for a long time disposed to consider *T. minor* as being merely the young stage of the larger *T. plumbea*; but the large specimens are comparatively so rare, that, for this reason alone, such an opinion seemed to me untenable. This is, I think, confirmed by the structure of the feet and of the caudal appendage.

Tomocerus niger, Bourlet.

Macrotoma nigra, Bourlet. Mem. Soc. Roy. Lille, 1839.
— *ferruginosa*, „ „ „ „
Tomocerus celer, Nicolet. Mem. Soc. Helv., 1842.
Macrotoma celer, Gervais. Ins. Aptères, vol. iii.

Macrotoma nigra, Gervais. Ins. Aptères, vol. iii.
— *ferruginosa*, „ „ „
— *lepida*, „ „ „ „
Tomocerus celer, Nicolet. Mem. Soc. Ent. France, 1847.
— *lepida*, „ „ „ „

Bourlet's description is as follows :

"Même longeur que la précédente (*T. plumbeus*) pour le corps et les antennes; corps couvert d'écailles noires, offrant à la vue simple un léger reflet argenté.

"Corps dépouillé de ses écailles présentant une couleur d'un jaune de cire. Bord antérieur du thorax garni d'une frange de poils noirs et courts ; antennes grises, ou d'un gris fauve ; pattes d'un brun verdâtre, tarses bruns, ventre jaunâtre. Cette espèce, ainsi que la précédente, se trouve sous les pierres et le vieux bois."

This species is narrower than *T. plumbeus*, and the body, when deprived of scales, is yellow instead of grey. It agrees so closely in other points with *T. plumbeus* that I long hesitated whether it should be regarded as a distinct species. Bourlet also seems to have felt some doubt, at least, after founding the species in his 1839 memoir, he omitted it in the later one.

It is found in the same localities as *T. plumbeus*, and is common throughout the year.

little longer than either of the two next, which are of equal size, the fifth longer than the third and fourth together. Head broader than the body. Antennæ longer than the body, 4-jointed, the first and second short, thick, and cylindrical; the third cylindrical, very long; the fourth short, of the same length as the second. Eyes none. The two branches of the caudal appendage, 3-jointed, setose; the first segment shorter than the base, the second somewhat longer, both cylindrical, the third as long as the first, ending in a point. Anal processes none?

Tritomurus scutellatus, Frauenfeld.

Tritomurus scutellatus, Frauenfeld. Ver. d. Zool. Bot. Ver. Wien., 1854.

This species much resembles *T. plumbeus*. In spirits of wine it is pale lead colour, and shines like silk. On the crown of the head, behind the antennæ, is a shield-like, black patch, rounded behind, angular in front.

Tritomurus macrocephalus, Kolenati.

Tritomurus macrocephalus, Kolenati. Sitz. d. k. Ak. d. Wiss. Wien, 1858.

Cylindrical, silvery white, with a trace of yellow, antennæ, feet, and spring deeper yellow, head large, crown arched, without black patches, body covered with short hairs; prothorax short but complete; metathorax with a long bristle; abdominal segments six in number, first and last the longest, intermediate ones short, subequal; antennæ rather more than half as long as the body, first two segments short, third long and with fourteen rounded projections on the under side.

Length of body ·0001 meter.

Common in summer in the Slouper Cave in Moravia.

There must, I think, be some mistake about the figure given by Kolenati.

Wankel, in the 'Verh. d. Zool. Bot. Ver. Wien,' for 1854, has described what appears to be a third species of this genus.

TEMPLETONIA, *Lubbock*.

Templetonia, Lubbock, Trans. Linn. Soc., 1862.

Plate LVI, figs. 8—11.

Body long, cylindrical, provided with clubbed hairs like those of *Degeeria* and *Orchesella*, and also with scales. Segments eight in number, subequal. Head direct, or nearly so. Antennæ longer than the head, 5-jointed; the basal segment short, the three following subequal, the apical ringed. Feet biunguiculate. Basal part of the saltatory appendage more than half as long as the two terminal lamellæ.

I proposed this genus in 1862 for the reception of Templeton's *Podura nitida*. The structure of the antennæ is alone sufficient to distinguish it from all the other genera of COLLEMBOLA They have five segments, of which the first is quite short, the three following are cylindrical and subequal, while the terminal is ringed

Templetonia crystallina, Muller.

Podura crystallina, Muller. Zool. Dan. Prod.
— *nitida*, Temp. Trans. Ent. Soc., vol. i.
— — Burm. Handb. d. Entom.
Heterotoma crystallina, Bourlet. Mem. Soc. Roy. Lille, 1839.
Degeeria margaritacea, Nic. Mem. Soc. Helv., 1842.
Ælheocerus crystallinus, Bourlet. Mem. Soc. Roy. Douai, 1842.
Podura nitida, Lucas. His. Nat. des Crus. Ar. et Myr.
Heterotoma crystallina, Gervais. His. Nat. Aptères,
Degeeria margaritacea, „ „ „ „
Orchesella crystallina, Nicolet. Ann. Soc. Ent. France, 1847.
Degeeria margaritacea, „ „ „ „
Isotoma nitida, „ „ „ „

Plate XX.

Templeton's description of this species (*l. c.* p. 94) is as follows:—"Body obovate, smooth, shining; head globular, a little produced anteriorly; eyes reddish-brown. Thoracic and abdominal rings pale, with innumerable reddish-brown streaks and spots, especially basally, and two or three strong hairs in the middle: a collar of similar hairs encircling the neck, and minute ones over the whole body. Antennæ and legs pellucid.

"Length ·09 inch."

This species is common in Kent. When alive, they are silvery white, so that at first they might easily be mistaken for specimens of *L. argentatus;* when, however, they have been for some few days in spirits of wine, the reddish spots mentioned by Templeton made their appearance.

Sweden, Switzerland, France, England, Ireland.

The brown eyepatch has one lens (Pl. LVI, fig. 9).

SEIRA, *Lubbock.*

Plate LVI, figs. 1—4.

Body scaly. Antennæ 4-jointed: terminal segment not ringed. Eyes on a dark patch. Thorax not projecting over the head. Abdominal segments unequal.

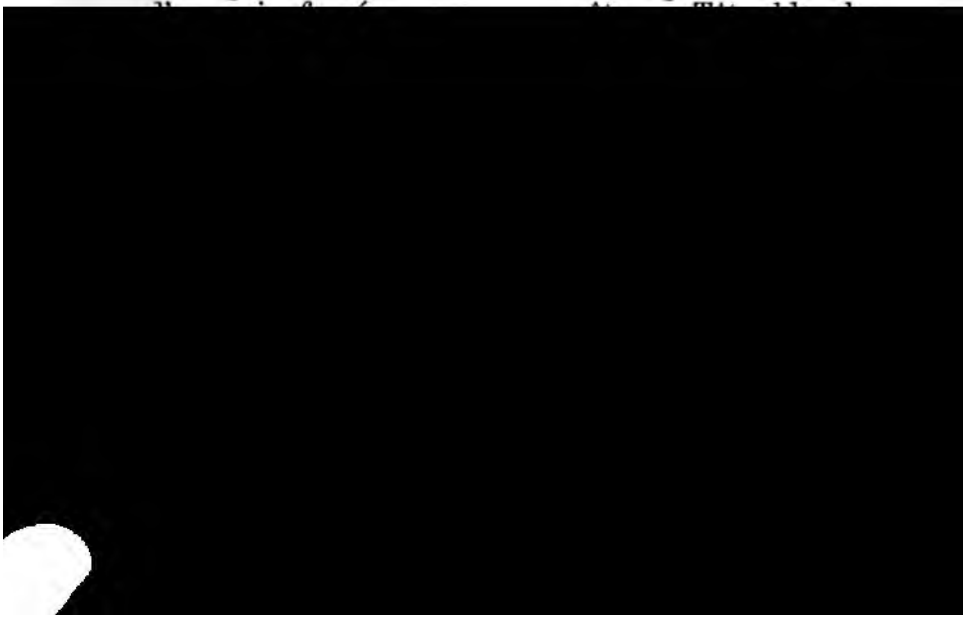
I have proposed this genus for the scaled species which were placed by Nicolet among the *Degeeriæ*, because it seems to me manifestly unnatural to unite in the same genus species with and without scales. Like the preceding genus, *Seira*[1] forms a very interesting link between several genera—a fact which I have endeavoured to indicate in the name. Indeed, some of the species approach very closely to *Lepidocyrtus;* and as regards *S. Buskii*, I was long in doubt whether to regard it as a *Seira* or a *Lepidocyrtus*. The form of the thorax, which is the characteristic on which the latter genus was founded, admits of every gradation, and therefore it is not very easy of application.

Seira domestica, Nicolet.

Degeeria domestica, Nicolet. Mem. Soc. Ent. Helv.
— — Aim. Soc. Ent. France, 1847.

Nicolet's description of this species is as follows:—

"Mêmes antennes que le précédent, mais blanches, ainsi que le dessous du corps, les pattes et la queue. Dessus du corps écailleux, d'un blanc sale très-luisant, avec quatre bandes transversales et plusieurs taches



Seira Buskii, Lubbock.

Seira Buskii, Lubbock. Trans. Linn. Soc., 1869.

Dark violet, with metallic reflections. Without the scales, the back and antennæ are dark violet, the head, legs, base of antennæ, and under surface yellowish. Eyes on a black patch, and connected by a dark band. Length $\frac{1}{15}$ of an inch.

The basal segment of the antennæ is rather shorter than the second or third, which, again, are, though very little, shorter than the apical. The hind legs are longest. The feet are all alike. There is one tenent hair, not much swollen at the end. The small claw is without teeth. The large one has three teeth on the inner, and one on the outer margin.

I have only found this species in greenhouses and hothouses; perhaps, therefore, it is not an indigenous British species.

Seira platani, Nicolet.

Degeeria platani, Nic. Mem. Soc. Helv., 1842.
Podura argenteo cincta, Bourlet. Mem. Soc. Roy. Douai, 1842.
Degeeria platani, Gervais. His. Ins. Aptères.
— — Nicolet. Ann. Soc. Ent. France, 1847.
— — Lubbock. Trans. Linn. Soc., vol. xxiii.

M. Nicolet's description of this species is as follows:—

"Corps écailleux, à reflet argenté, un peu plus fusiforme que celui du précédent, à tête plus petite et plus allongée, ayant les angles postérieurs arrondis. Poils noirs. Tête et premier segment thoracique d'un jaune-orange assez foncé, et bordés antérieurement de noir: second segment noir. Premier segment abdominal d'un jaune-orange-pâle; les deux suivants noirs, et séparés par une ligne transversale très-fine du même jaune et bordant le segment antérieur. Le quatrième segment, également orange-pâle, porte une large tache irrégulière noire sur son milieu, et une

ligne transversale de même couleur à son bord postérieur. Anus et bord postérieur de l'antépénultième segment également noirs. Antennes, pattes, dessous du corps et queue d'un jaune-pâle très-léger, les premières un peu plus foncées et annelées de noir ou de gris ; souvent un anneau noir à l'extrémité des cuisses postérieures.

" Longueur environ 2 millimètres. Se trouve sous les écorces du *Plantanus orientalis* ; assez commun en été ; vit solitaire."

I found my specimens on the bark of beech, in in company with *Psocus*, &c., and on dry boards.

Seira nigromaculata, Lubbock.

Grey ; the scales give it a mottled appearance. The eyes are on black patches. There is a dark band running along the side of the body, on the front margin of the mesothorax, and on the posterior edge of the third, fourth, and fifth abdominal segments. The third abdominal segment has also a transverse dark band in the middle, interrupted at the centre. The sixth abdominal segment is black. The legs are annulated ; the antennæ iron grey, the segments being

Seira pruni, Nicolet.

Degeeria pruni, Nic. Mem. Soc. Helv., 1842.
— — Gervais. His. Ins. Aptères, vol. iii.
— — Nicolet. Ann. Soc. Ent. France, 1847.

Même forme que le précédent, dont il ne diffère que par sa couleur. Corps écailleux, à reflet plombé, varié de brun, de gris, de noir et de blanc ; plus foncé à l'extrémité postérieure et sur les côtés latéraux, avec le premier segment thoracique d'un jaune orange moins foncé que dans l'espèce précédente. Tête du même jaune. Yeux et bouche noirs. Antennes grises avec la base des articles d'un jaune très pâle. Dessous du corps, pattes et queue de la même couleur ; pattes ayant les articulations et l'extrémité grises. Poils noirs.

Longueur 1½—2 millimètres. Assez commun sous les écorces du Cerasus et du Prunus vulgaris ; vit solitaire.

Seira elongata, Nicolet.

Degeeria elongata, Nicolet. Mem. Soc. Helv., 1842.
— — Gervais. His. Ins. Aptères, vol. iii.
— — Nicolet. Ann. Soc. Ent. France, 1847.

" Corps écailleux, assez velu, allongé, fusiforme à sa partie antérieure, rétréci et cylindrique à sa partie postérieure, et d'un gris plombé. Sixième segment aussi long que les quatre précédents pris ensemble. Tête, antennes, pattes, queue, dernier segment et dessous du corps d'un gris jaunâtre sale. Ecailles pointillées. Queue longue. Yeux noirs.

" Longueur 2 millimètres. Habite les maisons ; on le trouve dans les jointures des vieux meubles et des vieilles fenêtres et dans la poussière des appartements négligés ; assez commun ; vit solitaire."

Seira erudita.

Degeeri erudita, Nicolet. Mem. Soc. Helv.
— — Gervais. His. Ins. Apt. vol. iii.
— — Nicolet. Ann. Soc. Ent. France. 1847.

Assez semblable au précédent, dont il diffère par le sixième segment du corps, qui n'est pas plus long que les trois qui le précèdent pris ensemble et par la tête qui est plus large et moins allongée antérieurement. Corps écailleux, à reflet argenté, tacheté de brun sur un fond d'un blanc sale ou légèrement lavé de brun rouge. Tête de même couleur avec une tache brune en forme d'équerre au milieu. Yeux noirs. Antennes, pattes, queue et dessous du corps beaucoup plus pâles que le dessus, et sans taches. Poils gris.

Longueur 2 millimètres. Se trouve assez communément dans les bibliothèques, sur les vieux livres, les vieux papiers et dans les armoires qui renferment du linge ; vit solitaire.

Seira crassicornis, Nicolet.

Degeeria crassicornis, Nicolet in Gay.
— — „ Mem. Soc. Ent. France, 1847.

absence of eyes and the presence of scales. It is even more closely allied to *Lepidocyrtus*, from which the principal difference consists in the absence of eyes. *Templetonia* differs from *Beckia* in having the terminal segment of the antennæ ringed, and in the presence of a dark eye-patch, with a single lens. I have dedicated the genus to Mr. Beck.

Beckia argentea, Lubbock.

Beckia argentea, Lubbock. Trans. Linn. Soc., 1869.

Pl. XXIII.

Silvery, with bright metallic reflections. No eyes. Third segment of the antennæ rather shorter than the second or fourth. A thick fringe of hairs in front of the thorax. Filaments of the tail scarcely reaching to the ventral tube.

Length $\frac{1}{15}$ of an inch.

Beckia albinos, Nicolet.

Cyphoderus albinos, Nicolet. Mem. Soc. Helv., 1842.
Lepidocyrtus — Gervais. His. Ins. Apt., vol. iii.
Cyphoderus — Nicolet. Ann. Soc. Ent. France, 1847.
Lepidocyrtus — Lubbock. Trans. Linn. Soc., 1867.

Pl. XXIV.

Nicolet's description is as follows:

"Oblong, entièrement blanc; le premier et troisième article des antennes courts et en cône renversé; le deuxième et le quatrième beaucoup plus grands et oblongs. Corps peu velu et très brillant. Insecte très-agile.

"Longueur: environ 1 millimètre. Habite dans les troncs vermoulus et au pied des vieux arbres, où il vit en rassemblement nombreux, et sous les mousses des forêts, où il vit alors solitaire. Très commun surtout en automne et au commencement de l'hiver."

Silvery white. Third segment of antennæ much

shorter than the second or fourth. Thorax with a tuft of short and sparing hairs. Abdominal hairs short.

Switzerland. England.

Not very common.

Very active, runs in starts. The antennæ are in perpetual motion. It is very fond of pruning itself, and extremely careful to keep its feet clean.

LEPIDOCYRTUS, *Bourlet.*

Body, cylindrical. Segments unequal; mesothorax projecting more or less over the head. Eight eyes in each group.

Antennæ, 4-jointed, shorter than the body, which is covered with scales.

Feet biunguiculate. Caudal appendage long.

Lepidocyrtus curvicollis, Bourlet.

Lepidocyrtus curvicollis, Bourlet.		Mém. Soc. R. Lille, 1839; Mém. Soc. Douai, 1842.
Cyphodeirus capucinus, Nicolet.		Mém. Soc. Helv., 1842.
Lepidocyrtus curvicollis, Gervais.		Hist. Ins. Aptères, vol. iii.
— ***capucinus,***	,,	,, ,, ,,
Cyphodeirus —	Nicolet.	Ann. Soc. Ent., France, 1847.

Plate XXV.

dont les deux premiers articles sont d'un jaune plus pâle, et les deux derniers d'un gris assez foncé. Corps cylindrique, luisant, peu velu, à poils très-courts. Premier segment très-allongé antérieurement, triangulaire, creux en dessous et recouvrant la tête de manière à n'en laisser voir que le bord antérieur quand on la regarde en dessus. Deuxième segment, du double plus long que le suivant. Le sixième plus long que les trois précédents pris ensemble, et recouvert sur les côtés latéraux par un prolongement angulaire du cinquième. Yeux noirs. Filets de la queue blancs et finement striés transversalement.

Nicolet must, I think, have had before him immature or injured specimens. When full-grown, and unrubbed, this species is very beautiful, and reflects the most gorgeous metallic tints. Its general appearance is most singular; the depressed position of the head, and the gait, give it a ludricous resemblance to a Hippopotamus; and at the same time the body does not look as if it belonged to the head and legs, but rather as if it were some foreign object supported on the animal's back.

The head is scarcely visible from above. The fringe of scales on the front of the thorax is turned down; and there are a certain number of long hairs, some of them bent.

Some of my specimens laid their eggs in October; they were deposited in heaps, and were spherical, with a diameter of about $\frac{1}{150}$ of an inch. They were at first smooth, but after a few days were covered with filaments.

I have also met with specimens agreeing very closely with the above description, and which yet (see App.) have scales of quite a different character. The only other point on which these specimens differed from the others is that they have a tuft of short upright hairs on the front of the mesothorax. This does not appear to be a sexual difference, nor am I yet prepared to regard it as of specific importance.

Lepidocyrtus lignorum, Fabr.

Podura lignorum, Fabr. Ent. Sys.
— — Latr. Gen. Crust. et Ins.
— — Bois. et Lacord. Faun. Env. Paris.
Chorentes lignorum, Burmeister. Hand. de Ent.
Cyphodeirus — Nicolet Mem. Soc. Helv.
Lepidocyrtus argentatus, Bourlet. Mem. Soc. Roy. Douai, 1842.
— *lignorum*, Gervais. His. Ins, Apt., vol. iii.
Podura — Lucas. His. Nat. Crus. Arach. et Myr.
Cyphodeirus — Nicolet. Ann. Soc. Ent. France, 1847.
— *argentatus*, ,, ,, ,,
Lepidocyrtus — Lubbock. Trans. Linn. Soc. 1862.

Plate XXVI.

The description given by Fabricius is as follows :

" Plumbea, capite, thorace, pedibus furcaque pallidis. Habitat en Europæ lignis antiquis.

" Parva. Caput pallidum, ore antennisque nigris. Thorax subrotundus, pallidus, immaculatus. Abdomen plumbeum, furca nivea. Pedes pallidi."

Body cylindrical, the third segment decidedly narrower than the second and fourth ; silvery, with brilliant metallic reflexions. Eyes situate on a black patch. Antennæ and legs grey, the latter paler than the former ; basal segment of antenna short, second

is lanceolate. The first abdominal segment is decidedly narrower than those on each side of it.

It may well be doubted whether this is really the *L. argentatus* of Bourlet, his description being very brief and unsatisfactory. He says, "Thorace minus elato, corpore squamis argenteis," adding, in French, "Même taille que le précédent, thorax moins relevé et tête moins inclinée que chez le (*Lepidocyrtus*) *curvicollis*, corps revêtu en entier d'écailles d'un blanc argenté reflétant quelquefois une légère teinte cuivreuse; pubescence blanche, assez longue." He gives, however, no statement of the degree in which the thorax of *L. curvicollis* projects over the head.

Lepidocyrtus gibbulus, Nicolet.

Cyphoderus gibbulus,	Nicolet.	Mem. Soc. Helv.,	1842.
Lepidocyrtus ursularis,	Bourlet.	Mem. Soc. Roy. Douai,	1842.
— *gibbulus*,	Gervais.	Hist. Ins. Aptères.	
Isotoma pulex, ?	,,	,,	,,
Cyphoderus gibbulus,	Nicolet.	Ann. Soc. Ent. Aptères.	
— *pulex*,	,,	,,	,, ,,

Plate XXVII.

"Semblable au précédent *L. curvicollis* pour la couleur, mais plus court et proportionnellement plus large. Premier article des antennes jaune, les suivants d'un gris foncé, légèrement violacé. Premier segment du corps, très-convexe, peu prolongé en avant et cilié au bord antérieur. Deuxième segment, un peu plus long que le suivant. Bord inférieur du sixième segment rougeâtre. Filets de la queue courts et blancs. Pièce basilaire de la couleur du corps. Yeux noirs. Corps luisant, très-peu velu. Même reflet métallique que le précédent.

Longueur, 1 millimètre. Sous les mousses, et dans les jardins, assez rare; vit solitaire."

This species appears to be rare.

Lepidocyrtus violaceus, Geof.

Podura violacea, Geoff. Ins. Env. Paris, p. 611.
Isotoma — Bourlet. Mem. Soc. Roy. Douai, 1842.
— — Gervais. His. Ins. Aptères, vol. iii.
— *violaceus*, Nicolet. Mem. Soc. Ent. France, 1847, p. 382.
Cyphoderus — „ „ „ „ „

Plate XXVIII.

Body narrow, elongate.

Third segment of antennæ rather shorter than second. Iridescent, vivid purple and crimson; antennæ violet; legs yellowish.

Thorax with a tuft rather than a fringe of short upright spines; abdominal hairs short and sparing.

Thorax projecting in some attitudes completely over the head, and with a dark, median band in front, produced by reflexion, but having all the appearance of a depression.

Length $\frac{1}{20}$ of an inch; breadth across shoulder $\frac{1}{100}$.

They are active, but not so restless as some other species. Some kept by Mr. McIntire laid eggs in the spring.

Lepidocyrtus æneus, Nicolet.

racique, ce qui rend ce bord sinué. Du reste assez semblable au précédent.

" Longueur 1—2 millimètres. Cet insecte, très-agile, se trouve sous les mousses des forêts ; il est moins commun que le pusillus et vit solitaire."

I once found a specimen which agreed pretty well with the above description. The terminal segment of the antennæ was not, however, quite so long as the two preceding.

Lepidocyrtus purpureus, n. s.

Plate XXX.

Intensely deep blue, with beautiful purple reflexions. Legs and basal segment of antennæ yellow. Third segment of antennæ shorter than the second. Thorax with an upright fringe, and a central tuft of short setæ.

Length ·045 of an inch ; breadth ·013.

I am not acquainted with the following species :

Lepidocyrtus agilis, Nicolet.

Cyphodeirus agilis, Nicolet. Mem. Soc. Helv., 1842.
Lepidocyrtus — Gervais. His. Ins. Aptères, vol. iii.
Cyphodeirus — Nicolet. Ann. Soc. Ent. France, 1847.

D'un bleu métallique foncé, presque noir et uni, quand l'insecte est couvert d'écailles, et d'un brun clair, pointillé de brun foncé, avec une large bande transversale brune, presque noire, au milieu du corps, et quatre taches allongées et triangulaires au bord antérieur du dixième segment, quand il est depouillé. Les deux premiers articles des antennes, les pattes et la queue sont d'un jaune pâle. Le corps est hérissé de poils noirs ; enfin les yeux et les deux derniers articles des antennes sont noirs.

Longueur, environ 1 millimètre. Assez commun sous les mousses et dans les forêts.

Lepidocyrtus pusillus, Linn.

Podura pusilla, Linn. Sys. Nat.
— — Fabricius. Ent. Sys., p. 67.
— — O. Fabricius. Fauna. Grænl.
— — Latreille. Gen. Crus. et Insect., p. 77.
— — Bois. et Lac. Faun. Ent. Env. Paris.
Cyphodeirus pusilla, Nicolet. Mem. Soc. Helv., 1842, p. 65.
Podura — Lucas. Hist. Nat. Crus. Ar. et Myr., p. 565.
Lepidocyrtus pusillus, Gervais. His. Ins. Aptères.
— — Porath. Of. af k. Veteusk-Akad. Forh., 1869.

Linnæus says—

P. cylindrica ænea, furca alba.

Habitat in Europa, passum cursitat egregie exsultat.

Corpus omnium minimum, attente observandum ne oculos fugiat, totum ancum, oblongum et fère cylindricum.

Nicolet thus describes it—

Cylindrique, d'un bronze foncé et chatoyant. Antennes presque granuleuses, assez grosses et d'un gris foncé. Yeux noirs, bordés de jaune antérieurement. Corps hérissé ; premier segment peu prolongé et cilié au bord antérieur ; sixième segment aussi long que

Lepidocyrtus parvulus, Nicolet.

Cyphodeirus parvulus, Nicolet. Mem. Soc. Helv., 1842, p. 67.
Lepidocyrtus — Gervais. His. Ins. Aptères, vol. iii.
Cyphoderus — Nicolet. Ann. Soc. Ent. France, 1847.

D'un vert métallique très-foncé et uni quand l'insecte est couvert d'écailles ; moitié antérieure du corps d'un brun foncé pointillé de blanc ; le reste du corps d'un brun-clair pointillé de brun foncé quand l'insecte est dépouillé de ses écailles. Tête d'un brun jaunâtre. Yeux noirs. Antennes grises à base jaune. Pattes jaunes et queue blanche. Corps hérissé de poils noirs. Insecte très-agile.

Longueur, un peu moins d'un millimètre. Se trouve avec le précédent ; assez commun.

Lepidocyrtus flaveus, Nicolet.

Cyphoderus flaveus, Nicolet in Gay's Chili.
— — Mem. Soc. Ent. France, 1847, p. 383.

Omnino flavescens, oculi nigri.
Chili.

Lepidocyrtus giganteus, Nicolet.

Cyphoderus giganteus, Nicolet in Gay's Chili.

Lepidocyrtus iricolor, Say.

Podura iricolor, Say. Journ. Acad. Philadelphia, 1821.

Body blackish, iridescent; *thorax* with long hairs before; *abdomen* hairy at tip; *feet* hairy, whitish; *head* beneath and *antennæ* hairy.

Length nearly $\frac{1}{8}$ of an inch.

Cabinet of the academy.

Inhabits Pennsylvania, common.

DEGEERIA, *Nicolet.*

Body cylindrical, segment unequal. Eight eyes in each group. Antennæ shorter than the body, consisting of four subequal segments and a minute basal ring. Body covered with hairs, some of the ordinary form and some clubbed. Feet biunguiculate. Saltatory appendage long.

Degeeria nivalis, L.

Podura nivalis, Linn. Faun. Suec.
La podura jaune a anneaux noirs, Geoffrey. Ins. Env. Paris.
Podura nivalis, Linn. Syst. Nat.
— — Schrank. En. Ins. Austriæ.
— — Fabricius. Ent. Sys.
— — Muller. Zool. Dan. Prod.
— — Boisd. et Lac. Faun. Ent. Env. Paris.
— — Burmeister. Handb. der Ent.
— *annulata*, Fabricius. Ent. Sys.
— — Latreille. Gen. Crus. et Insect.
— — Boisd. et Lac. Faun. Env. Paris.
Choreutes nivalis, Burm. Handb. d. Entom.
Isotoma — Bourlet. Mem. Soc. Roy. Lille, 1839.
— *cursitans*, „ „ „ „
Degeeria nivalis, Nicolet. Mem. Soc. Helv., 1842.
Podura nivalis, Bourlet. Mem. Soc. Roy. Douai, 1842.
— *cursitans*, „ „ „ „
— *nivalis*, Lucas. Hist. Nat. Crus. Arach. et Myr.
Degeeria nivalis, Gervais. His. Ins. Aptères.

trois qui le précèdent pris ensemble. Pattes jaunes, et queue entièrement blanche."

He also describes two varieties.

My specimens, however, while corresponding with the above description in the general distribution of colour, differed in some points. The body, at the sixth abdominal segment, was as broad as in front; the black patch on the head was sometimes absent; the transverse dark line was often incomplete in the centre on the first and second abdominal segments, and the same was the case with the anterior band of the fourth; the fifth was dark behind; the antennæ were gray; and, finally, the anterior half of the head had a dark border. The species of this genus vary, however, a good deal in the distribution of the markings, and I am therefore unwilling to describe mine as new, especially as, in some respects, they appear to be intermediate between *D. nivalis* and *D. nigromaculata*.

The saltatory appendage scarcely reaches to the ventral tube.

Length ·077 of an inch.

Sweden, Switzerland, France, England.

Degeeria annulata, Fabr.

Podura arborea grisea, De Geer. Ges. d. Ins.
— *annulata*, Fabr. Ent. Syst.
— *nivalis*, Latreille. Gen. Crus. et. Ins.
— *annulata*, Bois. et Lac. Faun. Ent. Env. Paris.
— *nigromaculata*, Temp. Trans. Ent. Soc., vol. i.
— *minuta*, Burm. Hand. d. Entom.
Isotoma fusiformis, Bourlet. Mem. Soc Roy. Lille, 1839.
Podura cursitans „ „ „ Douai, 1842.
— *annulata* „ „ „ „
— *nigromaculata*, Lucas. His. Nat. Crus. Arach. et Myr.
— *annulata*, „ „ „ „
Isotoma fusiformis, Gervais. His. Ins. Apt., vol. iii.
Degeeria — Nicolet. Ann. Soc. Ent. France, 1847.
— — Herklots. Mem. de la Soc. Ent. des Pays Bas, 1858.

Body fusiform, pale greenish yellow or stone-colour. Head rounded, with a black fascia anteriorly, including

the eyes. The posterior ends of the second, fourth, and fifth segments with a more or less triangular black patch on each side of the middle line; posterior margin of the fifth segment black; posterior half of the sixth segment with a black patch, which is broad and more or less divided in front; posterior half of the seventh segment black; posterior segment brown. Along the sides are black patches, expanded sometimes into an almost continuous black band.

In other specimens the markings on the second and fourth segments are scarcely visible. The anterior part of the body is paler, the posterior part yellower, and the markings of a richer brown.

The antenna is, in reality, 5-jointed; but the basal segment is very small. The apical segment is not distinctly ringed, as is the case in the following genus.

The mandibles have four or five teeth.

The tarsus is provided with a tenent hair and two claws, as usual. The large claw has two teeth on the under side. The small claw is unarmed.

Length ·1 of an inch.

Under logs of wood in Kent, throughout the year.

Sweden, France, England, Ireland.

differently coloured, nor is the form of the abdominal segments the same. I have not therefore felt justified in uniting them.

Degeeria lanuginosa, Nicolet.

Degeeria lanuginosa, Nicolet. Mem. Soc. Helv., 1842.
— — Gervais. His. Ins. Aptères, vol. iii.
— — Nicolet. Ann. Soc. Ent. France, 1847.
— — Lubbock. Linn. Trans., vol. xxvi.

Pl. XXXIII.

"Fusiforme, entièrement d'un blond un peu verdâtre, avec les antennes, les pattes et la queue plus pâles que le reste du corps; celui-ci très-velu, à poils courts, serrés et légèrement laineux. Dessus hérissé, en outre de longs poils en massue, comme les autres espèces du même genre. Yeux noirs. Sixième segment du corps aussi long que les trois ou quatre précédens pris ensemble.

"Longueur: 1½ à 2 millimètres. Dans les jardins, sur la terre; assez commun; vit solitaire."

Not uncommon in England.

Degeeria Nicoletii, Lubbock.

Degeeria Nicoletii, Lubbock. Trans. Linn. Soc., 1867.

Pl. XXXIV.

Yellow; eyes on a black patch; terminal portion of antennæ tinted with violet; a reddish-brown band between the eyes; two brown patches on the posterior end of the fourth abdominal segment, and a band of the same colour on the posterior margin of the seventh.

Length about $\frac{1}{15}$ of an inch.

Common on bark and among grass, in spring and summer.

The antennæ are about three fifths of the length of the body. The basal segment is rather shorter, and the apical rather longer, than the two middle ones, which are of about the same length. Besides the short hairs pointing forwards, the three basal segments have a few rather longer ones, which stand out at right angles to the segment itself.

The brown band on the head between the eyes also projects a little behind them.

The mandibles have respectively three and five, rather blunt teeth.

The body is somewhat thickly clothed with hairs, which are of three sorts:—first, the ordinary short hairs, which are spread pretty evenly over the whole surface, as well as over the appendages; secondly, longer clubbed hairs, as in Pl. LXV, fig. 8; these generally stand at right angles to the skin, and are characteristic of *Degeeria* and *Orchesella;* they occur only on the body; thirdly, long, serrated hairs, most of which lie along the body, but some of those at the posterior extremity, as well as a few scattered ones on the legs, stand out at right angles. Lastly, there are on the fourth abdominal segment a few still longer, serrated hairs which have a curious bend near the middle, as in Pl. LXV, fig. 7; this bend is not accidental, as might

The antennæ have the two first segments pale at the base, dark at the apex, third segment dark, apical rather lighter. Legs yellowish; saltatory appendage white.

This species most nearly approaches the *D. platani* of Nicolet, but may be at once distinguished by the colour of the first abdominal segment, which in the latter species is pale.

It has no scales. Each leg has a tenent hair; and the large claw is provided with two teeth. It occurs on the bark of trees, and under logs of wood.

Length ·05 of an inch.

Found during spring and summer, in Kent and Lancashire.

The foreign species which have been described are as follows:

Degeeria disjuncta, Nicolet.

Degeeria disjuncta. Nic. Mem. Soc. Helv., 1842.
— — Gervais. His. Ins. Aptères.

"D'un jaune sale lavé de gris, avec le dessous du corps, les pattes, la queue et les antennes beaucoup plus pâles, ces dernières annelées d'un gris légèrement plus foncé. Yeux noirs. Trois bandes longitudinales de taches triangulaires et noires sur le dos; ces bandes s'étendent de la partie antérieure du thorax au bord postérieur du troisième segment abdominal; celui-ci bordé de noir postérieurement; quelques taches noires, dont le nombre et la disposition varient sur le sixième segment du corps; poils gris.

"Longeur: 1½ à 2 millimètres. Dans les forêts, sous les mousses, assez commun; vit solitaire."

I have never met with any specimens answering exactly to this description.

Degeeria corticalis, Nicolet.

Degeeria corticalis, Nic. Mem. Soc. Helv., 1842.
— — Gervais. His. Ins. Aptères.
— — Porath. Of. af k. Veteusk-Akad. Forh., 1869.

" D'un blanc sale en dessus et en dessous. Corps moins fusiforme que les précédens, presque cylindrique. Tête grosse, un peu plus large que le corps. Yeux noirs. Antennes blanches, annelées de gris foncé. Les deux premiers segmens du corps bordés de noir tout autour ; les deux suivans seulement sur les côtés latéraux. Une large bande noire, irrégulière et transversale sur le cinquième segment et une pareille sur le sixième ; ces deux bandes répétées en dessous du corps. Pattes et queue blanches.

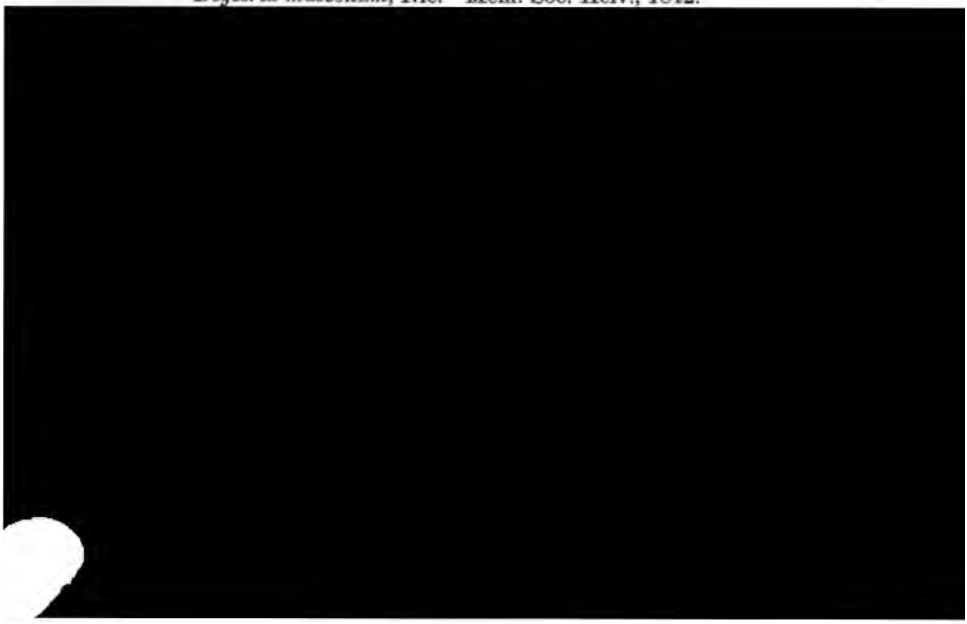
" Cette Podure ne saute pas volontiers, mais marche avec une très-grande vitesse.

" Longueur : $1\frac{1}{2}$ à 2 millimètres. Sous les écorces des chênes morts : assez commun à Chaumont."

I am not acquainted with this species.

Degeeria muscorum, Nicolet.

Degeeria musconum, Nic. Mem. Soc. Helv., 1842.



" Longueur : 1 à 2 millimètres. Sous les mousses en automne ; assez commun ; vit solitaire.

" On en trouve une variété dont toutes les taches, au lieu d'être rougeâtres sont noires. Cette différence vient probablement d'une différence d'âge."

The species may perhaps, I think, prove to be a young *Orchesella*.

Degeeria fenestrarum.

Isotoma fenestrarum, Bourlet. Mem. Soc. Roy. Lille, 1839.
— — Gervais. His. Ins. Aptères.

" 3 mill. D'un gris jaune, tachée de brun.

" Elle ressemble beaucoup à l'Isotome coureuse, elle en diffère cependant, non-seulement par sa couleur, d'un gris jaune, mais encore par les taches brunes dont son corps est marqué ; il y en a deux sur le deuxième segment abdominal, trois sur le suivant, et une au-dessous des yeux. Premier segment abdominal non bordé de noir : articles des antennes ayant leur sommet annelé de brun."

I am unable to offer any opinion about this species.

Degeeria variegata.

Podura variegata, Guer. and Per. Gen. de Ins.
Degeeria — Gervais. His. Ins. Aptères.

" Pale, varié de brun ; corps brillant ; antennes annelées de brun à leur base.

" Long., ·0003.

" Des environs de Paris."

Degeeria membranea.

Degeeria membranea, Nicolet in Gay's Chili.
— " Mem. Soc. Ent. France, 1857. P. 371.

Elongata, pallida. Antennis crassis longitudine

corporis. Abdominis segmento quarto duplo longior primis tribus conjunctim.

Chili.

This species closely resembles *D. crassicornis*.

Degeeria incerta, Nicolet.

Degeeria incerta, Nicolet in Gay's Chili.
— — „ Mem. Soc. Ent. France, 1847. P. 370.

Elongata, villosa fusco nigroque variegata. Pedibus furcâque flavescente nigro maculatis.

Chili.

Degeeria decora, Nicolet.

Degeeria decora, Nicolet in Gay's Chili.
— — „ Mem. Soc. Ent. France, 1847. P. 370.

Oblonga, depressa, flava, linea dorsali incisurisque nigris. Pedibus furcâque flavescentibus. Antennis primis articulis luteis ultimo nigro.

Chili.

Degeeria atra, Nicolet.

In considerable numbers under the bark of decaying live oak, &c., in Georgia and East Florida.

Isotoma, Bourlet.

Body cylindrical; segments subequal; seven eyes in each group; antennæ four-jointed, shorter than the body. No scales or clubbed hairs. Feet biunguiculate; caudal appendage long.

Isotoma arborea.

Podura campestris nigra, De Geer. Acta Soc. Upsal, 1740.
— *arborea nigra*, „ Ges. de Insect, vol. vii.
— — — Linn. Fauna Suec.
— — Linn. Sys. Nat.
— — Schrank. En. Ins. Austriæ.
— — Muller. Zool. Dan. Prod.
— — Fabricius. Ent. Syst.
— — Latreille. Gen. Crus. et Insect.
— — Burmeister. Handb. de Entom.
— — Boisd. and Lacord. Fauna. Env. Paris.
— *fuliginosa*, Templeton. Trans. Ent. Soc., vol. i.
Isotoma arborea, Bourlet. Mem. Soc. Roy. Lille, 1839.
— *rubricauda*, Bourl. Mem. Soc. Roy. Douai, 1842.
Desoria cylindrica, Nicolet. Mem. Soc. Helv., 1842.
— *pallida*, „ „ „ „
— *ebriosa*, „ „ „ „
Podura arborea, Bourlet. Mem. Soc. Roy. Douai, 1842.
— — Lucas. His. Nat. Crus. Ar. et Myr.
— *fuliginosa*, „ „ „
Desoria ebriosa, Gervais. His. Ins. Apt., vol. iii.
— *cylindrica*, „ „ „
Isotoma — Porath. Öf. af. k. Veteusk-Akad. Förh., 1869.

De Geer's description of this species is the following:—Podura oblonga nigra, antennis quadrinodiis; pedibus furcâque pallide fuscis.

Black, legs and spring pale; eyes black; antennæ scarcely longer than the head, with segments nearly equal in length. The whole body, including the legs and antennæ, is clothed with short hairs. The spring is short, and does not reach to the ventral tube.

The eggs are round and yellow, turning to purplish red.

The young when first hatched resemble their parents in general form, but are reddish in colour.

Sweden, Switzerland, France, Holland, Great Britain.

Found in the winter months.

Nicolet's *D. ebriosa* is founded on a pale specimen which was about to lay eggs. I have met with several individuals answering to his description, and have found that the colour of the abdomen was due to the yellow eggs contained in it. After they were laid, the posterior segments were of the same colour as the others. In darker specimens the skin is more opaque, and the eggs, therefore, do not affect the colour.

Isotoma viatica.

Podura viatica, Linn. Faun. Suec.
La podure noire terrestre, Geoff. Ins. Env. Paris.
Podura viatica, Linn. Fauna. Suec.
— — Boisd. and Lacord. Faun. Ent. Env. Paris.
Desoria — Nicolet. Mem. Soc. Helv., 1842.
Podura — Lucas. His. Nat. Crus. Arach. & Myr.
— — Gervais. His. Ins. Aptères, vol. iii.
Isotoma — Nicolet. Ann. Soc. Ent. France, 1847.

Isotoma viridis.

Podura viridis, Muller. Zool. Dan. Prod.
Isotoma — Bourlet. Mem. Soc. Roy. Lille, 1839.
— *cærulea*, „ „ „ „
Desoria virescens, Nicolet. Mem. Soc. Helv., 1842.
— *pallida*, „ „ „ „
Podura viridis, Bourlet. Mem. Soc. Roy. Douai, 1842.
Heterotoma chlorata, Gervais. His. Ins. Aptères, vol. iii.
Desoria pallida, „ „ „ „
— *virescens*, „ „ „ „
Isotoma viridis, „ „ „ „
— *cærulea*, „ „ „ „
— *Desmarestii*, „ „ „ „
— *virescens*, Nicolet. Ann. Soc. Ent. France, 1847.
— *pallida*, „ „ „ „

Green, with black eye patches; pale below; spring white; meso- and meta-thorax nearly equal in size; abdomen widening to the third segment; body clothed with short hairs.

Length ·1 of an inch.

Denmark, Switzerland, France, England.

Isotoma palustris.

Podura aquatica cinerea, De Geer. Act. Soc. Roy. Ups., 1740.
— *palustris*, Muller. Zool. Dan. Prod.
— *stagnorum*, Temp. Trans. Ent. Soc., vol. i.
— *grisea*, Burmeister. Handb. d. Entom.
— *palustris*, Bourlet. Mem. Soc. Roy. Douai, 1842.
Œtheocerus aquaticus, „ „ „ „
— — Gervais. His. Ins. Aptères, vol. iii.

Muller says, "Podura palustris, lutescens oculis lineaque dorsi media nigris; furca alba."

Templeton's description is as follows:—"Body elongate, obovate, pale. Head ovate; eyes black. Antennæ not much longer than the head. Thoracic and abdominal rings equal in length, pale, with a greenish transverse fascia occupying the posterior half of each ring, interrupted in the middle, an elongate triangle, with its base at the apex of each ring, occupying that part.

"Length ·05 inch.

"In some varieties a double row of black points down the back.

"Extremely common at Cranmore, on the surface of little pools of stagnant water. March, 1808."

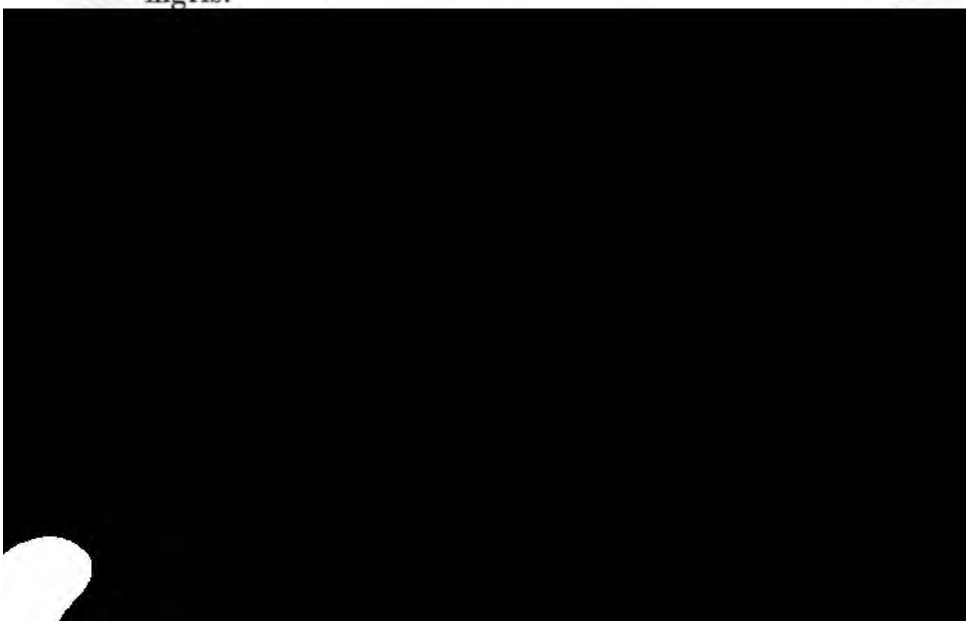
Sweden, France, England, Ireland.

Isotoma aquatilis.

Isotoma aquatilis, Muller. Zool. Dan. Prod.
— *trifasciata*, Bourlet. Mem. Soc. Roy. Lille, 1839.
— *bifasciata*, ,, ,, ,, ,,
Podura trifasciata, ,, ,, ,, Douai, 1842.
— *bifasciata*, ,, ,, ,, ,,
Desoria riparia, Nicolet. Mem. Soc. Helv., 1842.
— — Gervais. His. Ins. Apt., vol. iii.
Isotoma bifasciata, ,, ,, ,, ,,
— *trifasciata*, ,, ,, ,, ,,
— *riparia*, Nicolet. Ann. Soc. Ent. France, 1847.
— *bifasciata*, ,, ,, ,, ,,
— *lineata*, Lubbock. Trans. Linn. Soc., 1862.
— *riparia*, Porath. Of. af. k. Veteusk.-Akad. Forh., 1869.

Plate XXXVII.

Muller's description of this species is as follows:—"Cylindrica, flavicans, oculis, lateribusque abdominis nigris."



This is a variable species. The ground colour is greenish-yellow, and there are three lines of dark, irregular patches of brownish-purple; one along the centre of the back, and one on each side. In some specimens the dark patches are large, and become almost confluent; the creature then appears brown, with two irregular pale bands, and constitutes Bourlet's *I. bifasciata*; on the contrary, specimens in which the dark parts are restricted form his *I. trifasciata*. Again, in other specimens the dark parts are scarcely deeper in colour than the rest of the body; the intestinal canal then appears through the skin, and this variety constitutes, I believe, my *I. lineata* and Nicolet's *I. riparia*. Nothing but the comparison of a long series of specimens would have led me to regard insects which differ so much at first sight, as forming only one species.

That they do so, however, I have convinced myself, and I am even inclined to doubt whether this species is really distinct from the preceding.

Sweden, Switzerland, France, England.

Common in damp places, especially along the borders of quiet ponds.

The eggs, when first laid, are white, spherical, and smooth. Those I have seen were laid in captivity during the month of December. They were placed in a small heap without any arrangement.

Isotoma anglicana, Lubbock.

Isotoma anglicana, Lubbock. Trans. Linn. Soc., 1862.

Plate XXX.

Colour purplish-greenish brown. Eyes on a black patch. Under side of head and thorax the same colour as the back, but slightly paler. Antennæ considerably longer than the head. Anterior abdominal segments browner; saltatory appendage gradually passing into white towards the extremities. A few

scattered pale spots, and one or two pale lines, along the side. Basal segment of the antennæ rather shorter than the other three, which are nearly equal in length. Body covered with short hairs, and some longer setæ, especially on the thorax, and the posterior abdominal segments.

Length, ½ of an inch.

Found, during winter and spring, under logs of wood.

Some specimens, however, are paler, and more reddish-brown, wanting apparently the dark green; others are more green, from a deficiency of brown.

The body is about two and a half times as long as the antennæ. The mandibles are respectively four and five teeth. The maxillæ are short and stout.

The three feet are similar; they have no tenent hair; the large claw has an external tooth, and two small ones on the inner edge. The small claw has a single tooth on the outer margin.

The saltatory appendage reaches forward as far as the ventral tube.

Isotoma grisea, Lubbock.

species; but having watched them in their native haunts, and kept them for some time in confinement, I am satisfied that they constitute an independent species. My specimens do not exactly coincide with any of those described by Nicolet. The forms of the antennæ and of the spring distinguish it from the species forming his first section of the genus, nor is there any one in the second which it much resembles.

The following foreign species have also been described:

Isotoma saltans, Agassiz.

Desoria saltans,	Agassiz.	Bibl. Univ. Genèv.,	1841.
— *glacialis*,	Nicolet.	Mem. Soc. Helv.,	1842.
— —	Gervais.	His. Ins. Aptères.	
Isotoma —	Nicolet.	Ann. Soc. Ent. France,	1847.

Nicolet's description of this species is as follows:

"Entièrement d'un noir profond; très-velu. Poils courts et blancs. Cou très-distinct, un peu renflé. Thorax cylindrique. Abdomen légèrement fusiforme. Troisième article des antennes un peu ovoïde. Filets de la queue plus arqués que dans les espèces suivantes.

"Longueur: 2 millimètres.

"Cette espèce a déjà été décrite et figurée dans la 'Bibliothèque universelle de Genève' (1841, Tom. 32, p. 384), sous le nom de 'Desoria saltans,' que lui avait donné M. Agassiz; elle est très-abondante sur les glaciers des Alpes, d'où elle a été rapportée par M. Desor; elle y vit en société innombrable et pénètre même dans les fissures capillaires de la glace à plusieurs pouces de profondeur. Quelquefois certaines parties de la surface du glacier en sont noircies, tant cette podurelle est abondante."

Isotoma tigrina, Nic.

Desoria tigrina,	Nicolet.	Mem. Soc. Helv.,	1842.
— —	Gervais.	His. Ins. Aptères,	vol. iii.
—	Nicolet	Ann. Soc. Ent. France,	1847.

" Semblable au précédent (Is virescens) pour la forme, mais ayant les côtés latéraux du gris blanc très-pâle, tête plus foncée. Yeux noirs. Dos pointillé de noir ; une ligne longitudinale grise sur le milieu du dos.

" Longueur : 1—2 millimètres. Se trouve avec le précédent, dont il n'est peut-être qu'une variété ; assez rare et solitaire."

I have found specimens answering to this description, but cannot regard them as forming an independent species. They are, I think, immature individuals.

Isotoma fulvomaculata, Nic.

Desoria fulvomaculata,	Nicolet.	Mem. Soc. Helv., 1832.
—	—	Gervais.	His. Ins. Aptères, vol. iii.
—	—	Nicolet.	Ann. Soc. Ent. France, 1847.

" Corps large et court, comparé aux autres espèces du même genre, finement pointillé et portant des poils blancs. Côtés latéraux des segmens un peu anguleux ; bord postérieur de chaque segment légèrement superposé au bord antérieur du suivant. Tête et corps d'un brun noirâtre très-foncé, la première un peu moins sombre, et portant une légère dépression transversale entre les yeux, et une tache fauve découpée en forme de couronne un peu au-dessous. Plusieurs taches

"Très-petite. Tête et corps d'un cendre bleuâtre, pointillés de noir en dessus, plus pâle en dessous, avec deux lignes longitudinales de taches oblongues et pâles sur le dos, antennes blanchâtres, annelées de noir aux articulations. Yeux noirs. Premier segment abdominal assez court ; pattes blanches, pièce basilaire et queue de même couleur que le corps, filets terminaux blancs et transparens ; cette queue très-courte comparée a celle des autres espèces du genre. Insecte peu agile.

Longueur, 1—1½ millimètre. Très-abondante sous les écorces des vieux arbres, à Hauterive près de Neuchâtel ; vit en société."

This species seems to be found on young specimens of some larger species.

Isotoma annulata, Nic.

Desoria annulata,	Nicolet.	Mem. Soc. Helv., 1842.
—	—	Gervais.	His. Ins. Aptères, vol. iii.
Isotoma	—	Nicolet.	Ann. Soc. Ent. France, 1847.

D'un brun livide pâle, annelé de noir ou brun foncé. Corps très-velu. Yeux noirs. Quelques taches brunes sur la tête et le corps. Filets de la queue blancs.

Longueur : 3 millimètres. Dans les jardins sur la terre et sous les pierres, très-commune ; vit solitaire.

Isotoma fusca, Nic.

Desoria fusca,	Nicolet.	Mem. Soc. Helv., 1842
—	—	Gervais.	His. Ins. Apteres, vol. iii.
Isotoma	—	Nicolet.	Ann. Soc. Ent. France, 1847.

"Très-petite. Tête, antennes, pattes et queues d'un jaune foncé tirant sur le brun. Corps roux, très-velu et sans taches. Yeux et poils noirs. Tube intestinal indiqué, quand il est plein, par une bande dorsale plus foncée.

" Longueur : 1—2 millimètres. Sous les mousses des forêts ; assez rare et solitaire. —Variété. Même longueur ; à tête et corps jaunes, dessous du corps, antennes, pattes et queue blanchâtres. Yeux et une tache au milieu de la tête noirs. Articles des antennes gris au sommet. Se trouve le plus souvent sur les eaux stagnantes ; rare."

Isotoma spilosoma, Gervais.

Isotoma spilosoma, Gervais. His. Ins. Apteres, vol. iii.
— — Nicolet. Ann. Soc. Ent. France, 1847.

Gervais' description is very scanty.

" Corps vert jaunâtre, à deux rangées transversales de petites taches linéaires noires sur chaque anneau ; troisième article des antennes le plus grand ; pattes jaunâtres. Long. presque ·001.

" De Paris, dans les jardins."

I have never seen any specimens satisfactorily answering to this description.

Isotoma Gervaisii, Nicolet.

Isotoma Gervaisii, Nicolet. Mem. Soc. Ent. France, 1847.

Isotoma bicolor, Gay.

Podura bicolor, Gay. Jour. Acad. Philadelphia, 1821.

"*Body* plumbeous; *feet* with a few hairs, rather paler at base; *nails* small, acute; *spring* large, white; *eyes* deep black.

"Length from one tenth to three twentieths of an inch.

"Cabinet of the Academy.

"Our most common species, under stones, &c."

PODURIDÆ.

Body cylindrical. The appendages of the fourth abdominal segment developed into a saltatory apparatus.

This family closely resembles, and has hitherto been united with, the preceding. Previous writers, however, have not observed, or rather have not appreciated the importance of the fact, that the saltatory apparatus in this family is not homologous with that of the preceding. The sub-abdominal appendage constituting the saltatorial apparatus of the DEGEERIADÆ is as completely absent in the PODURIDÆ as in the LIPURIDÆ, but in the former family it is replaced by a similar apparatus representing the corresponding appendage of the fourth abdominal segment.

ACHORUTES, *Templeton*.

Body cylindrical. Segments subequal. Eyes eight on each side. Antennæ short, 4-jointed. Feet biunguiculate. No scales or clubbed hairs. Saltatory appendage short.

A. Without hooklets at the end of the abdomen.

Achorutes dubius, Templeton.

Achorutes dubius,	Temp.	Trans. Ent. Soc., vol. i.	
—	—	Lucas.	His. Nat. Anim. Art.
Podura Nicoleti,	Perty.	Mitt. des Naturf. Ges. Bern., 1849.	
—	—	Nicolet.	Ann. Soc. Ent. France, 1847.
—	***dubius***,	„	„ „ „

"Body subcylindrical, purplish-black, shiny, with scattered hairs. Head large, subtriangular, truncate anteriorly. Eyes remote from the base of the antennæ, which have the first two joints very short, the succeeding long and not much contracted. Apex of the abdomen ending obtusely.

"Length ·03 of an inch.

"Switzerland, England."

Templeton found this species on the surface of standing water. I met with it in great numbers on a sandbank at Alum Bay in the month of December.

This is the only species of this division of the genus which I have found in England. The other species on record are the following:

Achorutes similatus, Nicolet.

Switzerland, France.

According to Nicolet's figure the antennæ in this species differ from those of *A. dubius* in not tapering at the apex.

Achorutes cyanocephalus, Nicolet.

Podura cyanocephala, Nicolet. Mem. Soc. Helv., 1842.
Achorutes cyanocephalus, Gervais. His. Ins. Aptères, p. 438.
Hypogastrura agaricina, Bourlet. Mem. Soc. Roy. Douai, 1842.
Achorutes cyanocephalus, Nicolet. Ann. Soc. Ent. France, 1847.

"Petite, allongée, fusiforme; corps d'un blanc sale, pointillé et maculé de gris. Tête et antennes d'un bleu clair, la première offrante quelquefois de petites taches d'un brun léger. Yeux noirs. Pattes et queue blanches, cette dernière très petite. Cette Podure est un peu transparente et peu agile.

"Longueur 1 millim. En hiver, dans les caves humides; assez commune; vit en société."

This is probably the young of some other species. According to Nicolet's figure it possesses no hairs.

I have identified, although with doubt, Bourlet's *Hypogastrura agaricina* with this species.

Bourlet says "corps revêtu d'une pubescence courte et blanche," which is, no doubt, correct. His specimens were found on mushrooms.

Achorutes cellaris, Nicolet.

Podura cellaris, Nicolet. Mem. Soc. Helv., 1842.
Achorutes — Gervais. His. Ins. Aptères, p. 438.
— — Nicolet. Ann. Soc. Ent. France, 1847.

"Entièrement d'un blanc d'ivoire rélatant. Yeux peu visibles à cause de leur blancheur. Une ligne de points oblongs et enfoncés de chaque côté du corps.

"Longueur 1 millim. Dans les caves; très-rare."

Achorutes hyperborea, Boheman.

Podura hyperborea, Boheman. Of. af k. Vet.-Akad. Forh., 1865, No. 8.

"Oblonga, nigro-plumbea, opaca; antennis pedibusque brevibus; abdomine apice inermi. Long. 1 millim. In nive ad Belsund Dom. Sundevall; ad Horsund 1 Aug., copiose visa. Dom. Malmgren.

"Parva. Pod. armatæ, Nicolet, affinis et magnitudine æqualis, sed tota nigro-plumbea, segmento ultimo abdominis omnino inermi. Caput subtriangulare, supra fere planum, immaculatum. Oculi parvi, rotundati, vix convexi, nigri. Antennæ brevissimæ, sat crassæ. Abdomen cylindinum, pube brevissima, grisea, adspersum. Pedes breviusculi, crassi, vix pubescentes."

Prof. Boheman has had the goodness to send me, through Prof. Loven, some specimens of this species, and I have satisfied myself that it is a true *Achorutes*. The lesser claw is small, and there are two tenent hairs to each foot.

B. Species with abdominal hooklets.

sur le dos. Poils gris. Appendice saltatoire très court. Deux crochets recourbés en dessus a l'extrémité de l'abdomen, au dessus de l'anus.

"Longueur 1 millim. et demi. Sur les eaux stagnantes; peu commune."

Nicolet considers Bourlet's *H. fusco-viridis* to be referable to this species. Bourlet, however, does not mention the abdominal hooklets, and, on the whole, it seems to me more probable that Bourlet's *H. fusco-viridis* is Nicolet's *P. similata*.

Achorutes rufescens, Nicolet.

Podura rufescens,	Nicolet.	Mem. Soc. Helv., 1842.			
Achorutes —	Gervais.	His. Ins. Aptères, vol. iii.			
— *larvatus*,	„	„	„	„	
— *rufescens*,	Nicolet.	Ann. Soc. Ent. France, 1847.			
— —	Lubbock.	Trans. Linn. Soc., 1867.			
— —	Tullberg.	Skandinav. Podurider.			

"Yeux noirs. Tête et corps d'un rouge taille assez vif. Antennes et pattes d'un beau jaune orange. Crochets de l'abdomen trés-courts et presque droits.

"Longueur 1 millim. et demi; se trouve avec la précédente; assez rare."

Switzerland, Sweden, England.

Though Nicolet says "assez rare," I found this species common in winter among dead leaves.

Achorutes purpurescens, Lubbock.

Achorutes purpurescens,	Lubbock.	Trans. Linn. Soc., 1867.			
— —	Tullberg.	Skand. Podur.			

Plate XLI.

Brownish-purple, underside of body rather paler. Eyes not on a black patch. Body covered with short, scattered, white hairs; two clawed hooks at the posterior extremity of the body.

Length $\frac{1}{12}$ of an inch.

On a hotbed and under branches of trees, throughout the year.

I was at first disposed to refer this species to the *A. armatus* of Nicolet. It differs, however, in the colour of the body, and in the absence of brown spots on the back. Moreover, if I have been right in identifying the preceding species with the *A. armatus* (*Podura armata*) of Nicolet, it differs from the present in having larger abdominal hooks, and in the form of the caudal appendage, as may at once be seen by comparing Pl. LXIII, fig. 6, which represents the caudal appendage of *A. armatus*, with fig. 8 of the same plate, in which I have figured the corresponding organ of *A. purpurescens*. Again, in the present species the eye is not on a black patch.

The antennæ are short, and composed of four segments; the articulations are somewhat oblique; and the two terminal segments form a sort of club. The mandibles have respectively four and five teeth. The skin of the body, as well as of the appendages, is granular, and covered with short, scattered, smooth, white hairs.

The anterior feet have two or three long tenent hairs, which, however, are but little swollen at the extremity. The large claw bears a single tooth on the

Bourlet's description of this species is—

"1 mill. Dessus d'un noir mat, dessous d'un brun-gri-sâtre; pattes et queue d'un brun-verdâtre, ou d'un gris sale; organe saltatoire fort court, dépassant rarement le troisième segment abdominal, et ne paraissant jamais en arrière.—Très-commune sur les vieux murs en pierres calcaires pendant tout l'hiver."

The other species of the genus are as follows:

Achorutes bielanensis, Waga.

Achorutes bielanensis, Waga. Soc. Ent. France, vol. xi.
— — Gervais. His. Ins. Aptères, vol. iii.
— — Nicolet. Ann. Soc. Ent. France, 1847.

"Cinereo-cærulea, albidopilosa, tarsis furcâque albis, antennarum articulo ultimo longitudine trium precedentium.

"Long. 2 mill."

Hab. Warsaw.

This species is bluish-black, without eyes, and lives among dead leaves. It may be at once distinguished from the other species of *Achorutes* by the form of the posterior end of the body.

On the dorsal surface are a number of pores through which the animal emits, when attacked, a thick, white, bitter fluid, having an odour like that of *Polydesmus*, or of certain beetles.

M. Waga observed that the young have no trace of the caudal fork.

Achorutes humicola, O. Fabricius.

Podura humicola, O. Fabricius. Faun. Grœnl.

"P. fusco-cærulea, antennis brevibus, crassis; corpore cylindraceo versus anum crassiore.

"Length ·1 of an inch."

Norway and Greenland.

Achorutes hypnorum, O. Fabricius.

***Podura hypnorum*, O. Fabr. Kong. Dansk. Vid. Sels. Skr., 1783.**

"P. hypnorum, oblonga, virescens, postice fulvescens.
"Norway.
"Length ·1 of an inch."

Achorutes affinis, Lucas.

***Achorutes affinis*, Lucas. Exp. Sci. de l'Algérie.**

"Corpore capiteque cæruleo-cinereis, sparsim alpopilosis; antennis æqualiter cinereis; pedibus pallidis.
"Long. 2 mill."
This species does not appear to differ specifically from *A. murorum*.

Achorutes purpureus, Nicolet.

***Achorutes purpureus*, Nicolet. Mem. Soc. Ent. France, 1847.**

"Longueur ·001. D'un rouge violacé uniforme, plus pâle aux pattes et aux antennes ainsi qu'en dessous. Yeux noirs. Le pli transversal entre chaque segment du corps est jaune.

"Ocelli in macula nigra positi. Unguiculus superior sine dente, inferior parvus. Mucrones furculæ longitudine ⅔ dentium æquantes. Manubrium quam dentes longius. Spinæ anales perparvæ.

"Long. 1 millim."

This species is especially distinguished by the large and powerful basal portion of the spring, as well as by the length of the end segment compared with that of the teeth; the segment is crooked somewhat in the fashion of an S. The anal hooks are here visible only under an exceedingly high magnifier, and scarcely longer than they are broad, fixed to warts which are only insignificantly larger than the granules of the skin. The bases of these warts, which in *A. purpurescens* touch one another, are here pretty widely apart. The upper claws are almost completely toothless. In colour this species resembles entirely *A. purpurescens*.

Sweden.

PODURA, *Auct.*

Body cylindrical, segments subequal. Eyes eight on each side. Antennæ short, 4-jointed. Feet with only one claw. No scales or clubbed hairs. Caudal appendage short.

Podura aquatica, L.

Podura aquatica nigra, De Geer. Acta Soc. Reg. Sc. Upsal., 1740.
— — — Linn. Fauna Suec.
La podura noire aquatique, Geoffrey. Ins. Env. Paris.
Podura aquatica nigra, De Geer. Ges. de Ins.
— — Linn. Sys. Nat.
— — Schrank. En. Ins. Austriæ.
— — Fabricius. Ent. Syst.
— — Muller. Zool. Dan. Prod.
— — O. Fabricius. Fauna Grænl.
— — Latreille. Gen. Crus. et Ins.
— — Bois. et Luc. Faun. Ent. Env. Paris.
Achorutes — Burmeister. Hand. d. Entom.

Hypogastrura aquatica, Bourlet. Mem. Soc. Roy. Lille, 1839.
— — ,, ,, ,, Douai, 1842.
Podura — Nicolet. Mem. Soc. Helv., 1842.
— — Lucas. His. Nat. Anim. Art.
Achorutes aquaticus, Gervais. His. Ins. Aptères, vol. iii.
Podura aquatica, Nicolet. Ann. Soc. Ent. France, 1847.
— — Lubbock. Trans. Linn. Soc., 1867.

Plate XLII.

Opaque, blackish-blue; antennæ and legs reddish-brown. Filaments of caudal appendage curved and long, reaching beyond the second pair of legs.

Length ·08 of an inch.

Common on the surface of standing water.

Hab. Europe, from Sweden southwards to Switzerland, and westwards to Ireland. It also occurs in Greenland.

Podura Tullbergii, Lubbock.

Achorutes uniunguiculatus, Tullberg. Skand. Podur.

" Ocelli in macula nigra positi. Unguiculus superior sine dente, inferior nullus. Dentes furculæ triplo longiores quam mucrones. Spinæ anales parvæ, paullo longiores quam latæ, breviores quam papillæ."

Tullberg places this species in the genus *Achorutes*,

" Long. 1 millim. In nive ad Belsund Dom. Sundewall; ad Hornsund 1 Aug. copiose visa. Dom. Malmgren.

" Parva. Pod. armatæ Nicolet affinis et magnitudine æqualis, sed tota nigro-plumbea, segmento ultimo abdominis omnino inermi. Caput subtriangulare, supra fere planum, immaculatum. Oculi parvi, rotundati, vix convexi, nigri. Antennæ brevissimæ sat crassæ. Abdomen cylindricum, pube brevissima, grisea adepersum. Pedes breviusculi, crassi, vix pubescentes."

Hab. Spitzbergen.

XENYLLA, *Tullberg.*

" Corpus fusiforme. Primum segmentum thoracis a tergo parum conspicuum. Antennæ clavatæ. Ocelli 10, 5 in utroque latere capitis. Unguiculus inferior deest. Tubus ventralis brevissimus. Furcula parva, totius capitis longitudinem non æquans. Manubrium triangulum."

This genus differs from *Achorutes* in the form of the feet, from *Podura* in the spring, and from both these genera in the arrangement of the eyes. It contains two species, neither of which is known to me.

Xenylla maritima.

Achorutes maritimus, O. Fabr. Faun. Grænl.
Xenylla maritima, Tullberg. Skand. Podur.

Fabricius describes this species as follows:

" P. teretiuscula versus anum. Crassior cœruleonigricaus, abdomine albido.

" Habitat frequens ad littora super aquam marinam in cavernis rupium æstu remanentem, ubi continuo salit, non tamen se submergens. Sub fluxu maris littora petit, mare pacatum expectans."

Greenland, Sweden.

This is not the *A. maritimus* of Guérin, which is a *Lipura*.

Tullberg says, "Ocelli non in macula nigra positi. Unguiculus sine dente. Furcula saltui accomodata; tres partes ejus eadem interse longitudine; dentes et mucrones graciles acutique."

Long. $1\frac{1}{2}$ mill.

He regards his species as new, but does not allude to Fabricius's description, which, possibly, had not come under his notice.

Xenylla brevicauda, Tullberg.

***Xenylla brevicauda*, Tullberg. Skand. Podur.**

"Ocelli non in macula nigra positi. Unguiculus sine dente. Furcula ad saliendum inutilis, inchoata et imperfecta. Spinæ anales perparvæ.

"Long. $\frac{2}{3}$ millim."

The spring is in this species quite rudimentary. Colour greyish-blue, with dark spots.

Lipura ambulans, L.

Podura terrestris nivea, De Geer. Ges. de Ins.
— — — Fabricius. Ent. Sys.
— — — Latreille. Gen. Crus. et Insect.
Lipura ambulans, Burmeister. Handb. der Ent.
Anurophorus fimitarius, Nicolet. Mem. Soc. Helv.
Podura ambulans, Lucas. His. Nat. Crus. Ar. et Myr.
Adicranus fimetarius, Bourlet. Mem. Soc. Roy. Douai.
Lipura ambulans, Gervais. His. Ins. Aptères, vol. iii.
Anurophorus ambulans, Nicolet. Ann. Soc. Ent. France, 1847.
Lipura — Lubbock. Trans. Linn. Soc., vol. xxiii.
— — Tullberg. Skand. Podur.

Plate XLIII.

White. Prothorax short, but visible from above. Body covered with scattered hairs. Post-antennal organ consisting of twenty-eight elevations arranged in two rows. Legs short. At the posterior extremity of the abdomen are two short hooks, curved upwards. Skin granular.

Length ·06 of an inch.

Nicolet states that in this species the spiracles are very easily visible, and he figures them distinctly in his Pl. X, fig. 4. I believe, however, that these are merely small depressions. He also says, "Les yeux sont au nombre de vingt huit, divisés en deux groupes latéraux et disposés dans chaque groupe sur deux lignes parallèles obliquant transversalement derrière chaque antenne." It seems, however, very doubtful whether this structure is really an organ of vision, and Tullberg proposes to call it the "post-antennal" organ, which seems a convenient term.

Tullberg, who has paid great attention to this family, gives the following description, which differs in some respects from the preceding:

Tumores utriusque organi postantennalis circulares, 12—14, majores. Puncta ocelliformia in basi antennarum bina. Unguiculus superior sine dente, inferior ensiformis. Spinæ anales magnæ, arcuatæ.

Long. 2 millim.

This species is not the *P. ambulans* of Linnæus. Both in the 'Faun. Suec.' and in the 'Sys. Nat.' that species is described as having long caudal appendages. It is probably a *Campodea*.

Lipura Burmeisteri, Lubbock.

Plate XLIV.

White. Skin granular, sparsely covered with short, stiff hairs; antennæ clubbed.

Head large. Prothorax of moderate size. First three abdominal segments rather shorter and wider than the posterior thoracic; fourth abdominal segment rather narrower than the preceding; fifth still narrower, semicircular, rounded behind; sixth tapering, terminating in two strong, upturned hooks.

Length ·1 of an inch.

The mandibles have four teeth. The maxillæ are delicate and elongated.

The post-antennal organ (Pl. LXV, fig. 16) consists of two rows of oval prominences, situated transversely in a long hollow at the sides of the head. The rows are not contiguous. The prominences are attached so close to one another that they overlap in their broadest parts.

Lipura corticina, Bourlet.

Adicranus corticinus, Bourlet. Mem. Soc. Roy. Douai, 1842.
Anurophorus laricis, Nicolet. Mem. Soc. Helv., 1842.
Lipura laricis, Gervais. His. Ins. Aptères.
— *corticina*, „ „ „
Anurophorus laricis, Nicolet. Ann. Soc. Ent. France, 1847.
Lipura corticina, Lubbock. Trans. Linn. Soc., vol. xxiii.
Anurophorus laricis, Tullberg. Skand. Podur.

Plate XLV.

Bourlet's description is as follows:

"Noir, ou brun luisant, teinté de verdâtre; pattes hyalines; des yeux visibles; anus mutique; deux lignes enfoncées, parallèles, à la place de la ranieure ventrale; corps garni d'une pubescence rare et blanche; quelque longs poils blancs à l'extrémité de l'abdomen; quatrième article des antennes moins renflé et moins long."

Length 1—2½ millim.

Under bark.

Nicolet adds that the eyes are sixteen in number, "disposés par huit sur deux taches en lunule située en arrière des antennes."

Lipura fimetaria.

Podura fimetaria Linn. Sys. Nat.
— — Schrank. En. Ins. Austriæ.
— — Fabricius. Ent. Sys.
— — Muller. Zool. Dan. Prod.
— — Latreille. Gen. Crus et Insect.
Lipura — Burmeister. Hand. d. Ent.
Podura — Lucas. His. Nat. Anim. Art.
Anurophorus fimetarius, Nicolet. Ann. Soc. Ent. France, 1847.
Lipura fimetaria, Lubbock. Trans. Linn. Soc., 1867.
Anurophorus fimetarius, Porath. Of. af k. Vetensk.-Akad. Forh., 1869.

Plate XLVII.

White. Prothorax short, but visible from above. Second and third articulations of the antennæ oblique.

Post-antennal organ consisting of sixteen elevations in two oblong groups. Hairs few. Skin granular. No hooks at the extremity of the abdomen.

Length ·1 of an inch.

Common in damp earth throughout the year.

Sweden, Switzerland, France, England.

The antennæ are shorter than the head; they are 4-jointed and somewhat clubbed. The articulations between the second and third and third and fourth segments are oblique. The organ is covered with short, stiff hairs, which are most numerous on the apical segment.

The mandibles have four teeth each; in one of them the penultimate tooth projects beyond the others.

The body is thinly clothed with short scattered hairs. The legs are short. The principal claw is large and simple; the smaller one resembles a seta, but is thickened at the base. There are no tenent hairs.

This species has frequently been confounded with *L. ambulans*, which, no doubt, it somewhat resembles. They may, however, be at once distinguished by the posterior end of the abdomen, which in *L. ambulans* is armed with two small upright hooks; these are entirely absent in the present species. There is also a considerable difference in the post-antennal organ. In

September; they were fifteen in number, spherical, white, and $\frac{1}{180}$ of an inch in diameter.

This cannot be the *Podura fimetaria* of the 'Faun. Suec.,' as of that species Linnæus says, "atomorum volitantium instar saltat."

I kept some specimens of this species in confinement from the commencement of September until the June following, when unfortunately they were accidentally allowed to become too dry, and thus perished. They laid some eggs in September, which were hatched in about a month.

Lipura maritima, Guerin.

Achorutes maritimus, Guerin. Iconog. du Regne Animal, Texte Explic.
— — Lucas. His. Nat. Crus. Arach. et Myr.
— — Gervais. His. Ins. Apt., vol. iii.
Anoura maritima, Nicolet. Ann. Soc. Ent. France, 1847.
Anurida — Laboulbéne, ,, ,, 1864.
Lipura — Lubbock. Trans. Linn. Soc., 1867.

Plate LVII.

"Plumbea, velutine cærulescens, albidopilosa; stemmatibus quinque; tarsis albicantibus."

Length ·12 of an inch.

Eggs yellow.

Eyes five in number, two in front and three behind. Feet uniunguiculate.

The specimen figured was brought me by Dr. Allman from Kinsale, in Ireland. I have myself seen specimens of, I believe, the same species at St. Andrew's. It has been well described by M. Laboulbéne in the 'Ann. Soc. Ent. France,' but I cannot see any sufficient reason for the establishment of the genus *Anurida*.

L. maritima has in front of the eyes a curious organ (Pl. LXV, fig. 15), first observed by Laboulbéne, and called by him the "prostemmatic" or "anteocular' organ. He thus describes it:[1]—"Cet organ est formé

[1] 'Ann. Soc. Ent. de France,' 1864, p. 711.

par des espaces colorés tels que les représente la figure 7 ; leur couleur est très-noire. Le nombre des cercles rapprochés varie de 7 à 8, le plus ordinairement il y en a 7 mais je dois noter que j'en ai trouvé parfois 8 d'un côté et 7 de l'autre. Sur les jeunes individus, la disposition est très curieuse, la figure 9 en donne une idée ; il existe alors 22 à 24 espaces comprimés et serrés les uns contre les autres avec un espace central libre ; le tout rappelle la forme du fruit chez les plantes malvacées indigènes, entre autres les *Malva* et les *Althœa*. Quelque soin que j'aie mis à chercher si du point central il naissait un poil allongé ou toute autre production dermique, je dois dire que je n'en ai point trouvé." Tullberg regards this organ as homologous with the so-called "eyes" of *Lipura fimetaria*, and suggests that the term "post-antennal" would be preferable to "anteocular," since it exists in some blind species.

The remaining species are not known to me.

Lipura armata, Tullberg.

Lipura armata, Tullberg. Skand. Podur.

Lipura dubia, Nicolet.

Anurophorus dubius, Nicolet in Gay's, Chili.

"Omnino testacea; antennis longitudine capitis, duodecim oculis."

Lipura certa, Nicolet.

Anurophorus certus, Nicolet in Gay's Chili.

Corpore pedibusque fusco testaceis; sexdecim oculis.

Lipura Kollarii, Kolenati.

Anurophorus Kollarii, Kolenati. Sitz. de k. Akad. d. Wiss., 1858.

Cylindrical, behind somewhat widened, rose-red; antennæ, feet, and anal appendages, light yellow; the whole body covered with short hairs, the feet and sides of the body with bristles, of which four at the posterior end of the body are longer than the rest; four ocelli in a curved row between the ordinary eyes; head rounded, heart-shaped; penultimate abdominal segment the shortest, the last the longest; terminal segment of the antenna longer than the rest.

Length ·0012 meter.

Found in the high Alps of Styria. Frequent in summer.

If M. Kolenati is correct in his account of the ocelli, this species is very distinct from any of its allies. The description, however, I think needs confirmation.

The caudal hooks are rather large.

Lipura stillicidii, Schiödte.

Anurophorus stillicidii, Schiödte. Kong. Danske. Vid.-Selk., 1849.

"Niveus, oculis viginti octo; antennis capite dupl. longioribus; segmentis thoracicis bilobis.

"Long. $1\frac{1}{2}$ lin. Oblongus, convexiusculus, pubescentia albissima parce indutus.

"Caput triangulare, apice obtuso, angulis posterioribus late rotundatis. *Ocelli* utrinque quatuordecim, minutissimi, colore albissimo, in lineam oblique transversam subsinuatam, pone antennas bifariam dispositi: ocelli septem seriei anterioris, posterioris sex; ocellus quartus decimus reliquis paullo major, interiorem claudens hiatum serierum.

"*Antennæ* capite duplo fere longiores, validæ, cylindraceæ; *articulus primus* brevissimus, obconicus; secundus hoc duplo longior, clavatus; *tertius* forma eadem, sed paullo brevior; *articulus ultimus* duplo longior tertio, subclavatus, apice rotundato.

"*Thorax* capite *duplo* longior et ultra, segmenta longitudine subaequalia, singula sulco medio, transverso, profundius bipartita, utrinque biloba, parte posteriori angustiore, anterior prothoracis portio capite

in his capite breviores, articulo ultimo subgloboso, segmentaque thoracica obsoletius lobata, æqualia superne indivisa."

Common in the Adelsberg caves.

The post-antennal organ resembles that of *L. fimetaria*, and consists, as in that species, of fourteen small circular elevations, called eyes in the preceding description, arranged in two parallel rows of seven each. It may, I think, be regarded as an additional reason for doubting whether this curious organ is really an eye, that in every other species described by Schiödte as occurring in the depths of the Adelsberg caves the eyes have disappeared.

In the Mitchelstown cave, near Cahir, in Ireland, Dr. Percival Wright and Mr. Haliday[1] found specimens of *Lipura* so closely resembling Schiödte's species that they did not feel justified in proposing for it a new specific name. The thoracic segments, however, "presented no such strong stricture across the middle as Schiödte has described and figured."

ANOURIDÆ.

Antennæ 4-jointed, short, conical. No mandibles nor maxillæ. Segments of abdomen subequal.

Plate LVI, figs. 27—29.

Anoura muscorum.

Achorutes muscorum, Temp. Trans. Ent. Soc., vol. i.
— — Burmeister. Handb. d. Entom.
— — Lucas. His. Nat. Crus. Ar. et Myr.
— *tuberculatus*, Nicolet. Mem. Soc. Helv., 1842.
— — Gervais. His. Ins. Aptères.
Anoura tuberculata, Nicolet. Mem. Soc. Ent. France, 1847.
— *muscorum*, Lubbock. Trans. Linn. Soc., vol. xxiii.
— — Tullberg. Skand. Podur.

[1] 'Natural History Review,' 1857.

Achorutes tuberculatus, Porath. Of. af k. Vetensk.-Akad., Forh., 1869.

Plate XLVIII.

"Body subcylindrical, turned posteriorly, and ending with two mammillæ; dark purplish. Head short, triangular. Eyes not remote from the base of the antennæ, which are very short, and have the first joint very large, the succeeding necessarily diminishing in size, last acuminate. Legs pale blue. Rings with strong spiny hairs in rows along the back; hairs usually arising in pairs."

Length ·07 of an inch.

Under sticks and bark.

The eyes are three in number on each side of the head, one being at some little distance from the other two.

Common.

Sweden, Switzerland, France, England, Ireland.

Anoura granaria, Nicolet.

Anoura granaria, Nicolet. Ann. Soc. Ent. France, 1847.
— — Lubbock. Trans. Linn. Soc., 1862.
Anurida — Tullberg. Skand. Podur.

son orifice est indiqué par une petite fente transversale très-distincte; les pattes se terminent par un crochet unique assez allongé: enfin le segment anal se compose de trois mamelons hémisphériques, un supérieur et deux intérieurs, au centre desquels est l'anus.

" Cette fort jolie espèce est très-rare; elle a été trouvée au chemin de ronde de la barrière de la gare, à Paris, sous des morceaux de détritus; au premier aspect, elle pourrait être prise pour la variété blanche de l'*Anoura tuberculata*, mais l'absence complète de tubercules et ses segments granulés en font une espèce bien distincte."

I have not met with this species very often.

Sweden, France, England.

The following foreign species I do not know.

Anoura rosea, Gervais.

Anoura rosea, Gervais. His. Ins. Aptères, p. 443.

" Entièrement de couleur rose, à corps mamelonné comme celui de l'espèce précédente et dont les poils sont également portés par des tubercules; tête rostrée en avant pour la trompe.

" Long. 0·001."

This species was found by Gervais in the hothouses of the Jardin des Plantes, and is, therefore, very likely an exotic form.

Anoura atra, Nicolet.

Anoura atra, Nicolet in Gay's Chili.

Nigra, pedibus siphonisque pallidè fuscis.

Chili.

Anoura albipes, Nicolet.

***Anoura albipes*, Nicolet in Gay's Chili.**

Nigra, pedibus siphonisque albis.
Chili.

Anoura Chilensis, Nicolet.

***Anoura Chilensis*, Nicolet in Gay's Chili.**

Cinerea, articulus primus antennarum manifesté brevior secundo. Pedes pallidi.
Long. 0·005.
Chili.

THYSANURA.

In Great Britain this order is much less numerously represented, both in species and in individuals, than the Collembola. Indeed, I am only acquainted with four British species, belonging to three, if not four different genera. The Thysanura fall into two well-marked divisions, represented by the *Lepismidæ* on the one hand, the *Iapygidæ* and *Nicoletiadæ* on the other. The former are clothed with scales, the latter with hairs only. The *Lepismidæ* appear to prefer dry and warm or even hot localities, while the Collembola frequent damp places, and apparently are most numerous in the temperate regions of the earth.

General Organization.

The body consists of the head, three thoracic and ten well-marked abdominal segments. The *Lepismidæ* are covered with scales, which, however, are altogether wanting in *Nicoletia*, *Campodea*, and *Iapyx*. The head is distinct, sometimes more or less covered by the thorax. The eyes are large, compound, and contiguous, in *Machilis;* small and far apart in *Lepisma;* *Iapyx* has no eyes, and the same is the case, according to Gervais, with *Nicoletia* and *Campodea*. Westwood also is of the same opinion as regards *Campodea*, in which genus, moreover, neither Meinert nor I have been able to discover any eyes. Nicolet, on the contrary, describes seven ocelli on each side of the head in *Nicoletia*, and six in *Campodea*.

The antennæ are large and multiarticulate, sometimes even longer than the body, and generally tapering towards the apex. In *Campodea*, on the contrary (Pl. LXVI, fig. 13), the terminal segment is slightly swollen, and has at its extremities a tuft of hairs.

The mouth parts consist of a labium, mandibles, maxillæ, maxillary palpi, lingula, labial palpi, and labium.

The mandibles of *Lepisma* (Pl. LXVI, figs. 8 and 9) are short, curved, strong, and horny. Those of *Machilis* more nearly resemble the corresponding organs of the COLLEMBOLA; they are comparatively weak, elongated, and tapering towards the extremity, which is obtuse, and have only rudimentary teeth; the molar portion is much developed, and projects at right angles to the rest of the organ.

In *Campodea* and *Iapyx* the mandibles are curved, with three or four teeth, but the molar projection is not well developed.

The maxillæ in *Lepisma* (Pl. LXVI, fig. 10) consist of an outer fleshy, cylindrical lobe, and an inner tapering portion, which is triangular in form, clothed with long hairs along its inner margin, and terminates in a horny point. The maxillary palpi are well developed and 5-jointed. The maxilla of *Machilis* (Pl. LXVI, fig. 3) is formed on the same plan, but is larger; the inner maxillary lobe is 2-jointed, the terminal portion being tripartite; the outer process is rounded at the extremity and horny; the two inner ones are needle-shaped, sharp, unequal, the inner one being the lesser of the two. The maxillary palpi are long and 7-jointed. The basal segment has a process regarded by Latreille as representing the cylindrical appendage of the posterior legs. It is probable that the form of the maxillæ differs in different species; *M. maritimus* does not seem to agree with *M. annulicornis* as described by Latreille. Neither Nicolet nor Gervais describes the maxillæ of *Nicoletia;* the palpi are in that genus said

to be 5-jointed. The maxillæ of *Iapyx* are thus described by Meinert:

"The maxillæ[1] are connected with the lingua, and, together with the latter and the paraglossæ, supported by a peculiar internal framework of thin chitinous pieces, of which the construction will appear more fully from figure 3. The most prominent part of the maxilla is the inner lobe, which is more strongly chitinised than the other parts, hooked or sickle-shaped, and carries on its concave inward edge five curved, deeply subdivided, smaller lobes or lamellæ. The inner maxillary lobe is supported by the stipes, which is tolerably firm, elongated, and flat. From the basal extremity of the stipes a thin chitinous piece can be traced connecting it with the outer branch of the framework just mentioned, and this I look upon as representing the cardo or hinge of the maxilla. The outer lobe is membranaceous, and has near its anterior margin a small conical protuberance. There is a distinct palpiger carrying a biarticulate palpus."

The maxillæ of *Campodea* are somewhat less developed than those of the other genera, and, indeed, more closely resemble those of the COLLEMBOLA. The terminal lobes are more numerous, and the maxillary palpi are inarticulate.

The lingua is membranous, delicate, and bilobed.

The lower lip in *Lepisma* (Pl. LXVI, fig. 11) consists of four fleshy, subequal lobes; the palpi are 4-jointed, and the two terminal segments are much enlarged. In *Machilis maritimus* the labium is more distinctly divided along the middle line, and has three lobes on each side. The palpi are rather more elongated, but not swollen at the apex. According to Nicolet the labial palpi of *Nicoletia* are composed "de quatre articles formant massue, le dernier gros et ovoide." The labium of *Campodea* is bifid, and each half is divided into two pieces by a transverse groove; from the hindmost divisions rise the short conical, hairy, labial palpi,

[1] 'Ann. and Mag. of Nat. Hist.,' 1867, p. 368.

which near their apices each carry two long subuliform setæ.

The three thoracic segments are distinct, and bear each a pair of legs. In some cases, as in *Nicoletia*, the three segments are similar in form and not very different in size; in *Campodea*, on the contrary, the prothorax is much smaller than the other two, and the mesothorax is the largest of the three. In *Lepisma* the thoracic segments are wide and depressed; the prothorax is excavated for the reception of the head, the metathorax for that of the first abdominal segment. In *Machilis* the prothorax is compressed and tubular; the mesothorax is, on the contrary, large, raised, and, as it were, arched. In *Lepismina* the thorax, and especially the prothorax, is very much enlarged, so that the body becomes almost heart-shaped.

The legs are of moderate length and are clothed with hairs, as also, in certain species, with scales. They are not saltatorial, and the three pairs do not differ much in length, though the posterior pair is generally somewhat the largest of the three. In *Machilis* and *Lepisma* the tarsi are biunguiculate; the claws are horny and terminal, as in true insects. In *Iapyx*[1] (Pl. LXV, fig. 12) the claws "are large, foliaceous, but of unequal length. The empodium is well developed and supported

One of the most interesting points in the organization of this group is the possession of subabdominal appendages.

Machilis maritimus, for instance, has a pair of elongated, cylindrical appendages attached to every segment excepting the first. In *Lepisma saccharina*, and in *Iapyx*, on the contrary, these appendages are represented by mere groups of stiff hairs. The anterior subabdominal appendages of *Nicoletia* and of *Campodea* much resemble those of *Machilis;* in the former genus they are said by Nicolet[1] to be "accompagnées chacune au côté interne d'un petit corps vesiculeux et ovale faisant probablement partie des organes de la respiration."

The ovipositor of *Machilis* is composed of four elongated, cylindrical, narrow, rod-like appendages, of which the two anterior belong to the eighth (Pl. LXVI, fig. 6), the two posterior to the ninth (Pl. LXVI, fig. 5), segment. In the male there is a broader, shorter, and somewhat spatulate process (Pl. LXVI, fig. 7) on the under-side of the ninth segment. Latreille observes[2] that the ovipositor "part du dessous du onzième segment du corps, les trois du thorax compris," and adds that it is "formé comme dans les Tenthrédines, les Sauterelles, &c., de deux pièces étroites, allongées, très comprimées, pointues au bout, appliquées l'une contre l'autre par leur face interne, demi transparentes et garnies de petits poils." In fact, however, it consists of four such slender rods, two belonging to the eighth and two to the ninth abdominal segment. The short description given by Dr. Dickie[3] seems, therefore, to me substantially correct. He says of the rods, however, that they are "slightly club-shaped." They do not appear to me to be either club-shaped or pointed.

In *Lepisma* the subabdominal appendages are confined to two of the posterior segments, although they are indicated on the anterior segments by groups of

[1] 'Ann. Soc. Ent. France,' 1847, p. 353.
[2] 'Nov. Ann. d. Museum,' vol. i.
[3] 'Trans. British Assoc.,' 1855, p. 110.

stiff yellow setæ. As in *Machilis*, the ovipositor consists of four long rod-like appendages belonging to the eighth and ninth segments. M. Lacaze Duthiers was quite mistaken in asserting[1] that the ovipositor of *Lepisma* had been overlooked by entomologists. On the contrary, it was described and figured, although not very clearly or elaborately, by Treviranus,[2] while that of *Machilis* was figured by Leach,[3] Templeton,[4] and Nicolet.[5] Gervais also has indicated the ovipositor in several of his figures;[6] on the contrary, in the text he appears to confuse the ovipositor with the central caudal appendage, for he says "le median, que Latreille a nommé tarière, manque dans les Campodées," which he contrasts in this respect with *Nicoletia*. The central caudal appendage in that genus, indeed, corresponds truly with that of *Machilis*, which, however, is quite distinct from the ovipositor,

M. Lacaze Duthiers thus sums up his view of the abdominal homologies in *Lepisma*:—"L'abdomen," he says,[7] "se compose de onze urites, example de plus a l'appui de cette opinion, à savoir que le nombre normal des urites n'est point neuf, mais bien onze. Les huit premiers se composent d'un sternite et d'un tergite, celui-ci embrasse le premier par ses bords qui descendent très-bas sur les côtés. L'ennaturite forme l'armure.

ternite." On the contrary, the abdomen seems to me to consist of ten segments, the dorsal arches of which are regularly formed. I agree also with Dr. Dickie that the ovipositor is formed by elements which belong partially to the eighth and partially to the ninth segment. The posterior margin of the ninth ventral abdominal plate is deeply bifid (Pl. LXVI, fig. 5), and forms four triangular projections, of which the two central project nearly twice as far as the lateral.

According to Nicolet's figure,[1] *Nicoletia* has a well-developed ovipositor.

In *Iapyx* the eighth and ninth abdominal segments are altogether deprived of ventral appendages, and this is also the case in *Campodea*. The sexual orifice is situated, as in the other genera, behind the eighth ventral shield in a conical protuberance, which is simple in the male, but in the female almost bifid.

The posterior abdominal segment bears three appendages in *Lepisma*, *Lepismina*, *Machilis*, and *Nicoletia*, but only two in *Campodea*. In *Lepisma* they are nearly equal in size; in *Lepismina* and *Nicoletia* the central is longer than the two lateral, and this difference is still more marked in *Machilis*. In *Lepismina* the appendages are short; in *Lepisma*, *Machilis*, *Nicoletia*, and *Campodea*, they are long and multiarticulate. Lastly, in *Iapyx* they are modified into a pair of horny forceps, which give the animal very much the appearance of a *Forficula*.

Internal Anatomy.

The respiration is tracheal. Treviranus was himself at first of this opinion, but subsequently abandoned it, and came to the conclusion that *Lepisma* breathes through the general surface of the skin. He even asks whether the scales are not perhaps respiratory organs! Latreille

[1] 'Ann. Soc. Ent. France,' 1847, pl. v, fig. 10.

also was unable to find any special respiratory organs in *Machilis*.[1] Yet, though the tracheæ are not largely developed in the *Thysanura*, in fresh specimens of *Lepisma* they are easy to see. In *Campodea*, according to Meinert, the spiracles are six in number, two for each of the thoracic rings. The prothoracic spiracles are the largest, and are situated on the underside, at the posterior margin of the prosternum. The two other pairs, on the contrary, are situated on the upper side, behind the dorsal shields of the second and third thoracic segments. In this genus there are no abdominal spiracles.

In *Iapyx*, on the contrary, there are ten pairs of spiracles, "situated in the side folds of the first ten rings."[2]

The nervous system consists of a supracœsophegeal and eleven subœsophageal ganglia.

The digestive canal is a straight tube. In *Lepisma*[3] it consists of a pharynx, an œsophagus which gradually enlarges so as to form a first stomach, a crop, with six horny teeth, a true or second stomach, a narrow ilium, and a somewhat wider rectum or colon. The Malpighian vessels are four in number and filiform, situated in front of the ilium. In *Campodea*, on the contrary, there are no Malpighian vessels, but the

In *Machilis* the generative organs also open between the eighth and ninth segment, but the ovary, instead of being a simple tube, gives off, on its inner side, seven short egg-tubes, which lie above the intestine. These latter, therefore, are fourteen in number; and in the beginning of September, when I examined them, each tube generally contained towards its lower end three egg-germs, in which a considerable deposition of yelk had taken place; and towards its free extremity from fifteen to twenty egg-germs in earlier stages of formation.

The egg-tube is lined with epithelial cells, generally from $\frac{1}{700}$th to $\frac{1}{1000}$th of an inch in diameter. Their nuclei are about $\frac{1}{2500}$th of an inch in diameter, and very faint. Often, indeed, they can scarcely be perceived; but, generally, when the tube had been lying some time in syrup, they became tolerably plain. At the free end of the egg-tube are some apparently solid nuclei, about as large as those of the epithelial cells, and only differing from them in being more distinct, and possessing granular contents.

These nuclei are generally all about the same size; sometimes, however, one or two are larger than usual; and as this was the case in the first specimen I examined, I was inclined to believe that the nuclei increased in size, and thus became the Purkinjean vessels. As I was not able in other specimens, however, to find any nuclei in the process of becoming Purkinjean vessels, this view requires confirmation, though it is supported by the analogy of other animals.

Although in an unaltered condition the epithelial cells of the egg-tube are very faint, and often altogether invisible, yet if pure water be added and the syrup be removed, the cell-walls and the epithelial nuclei gradually become quite plain. Most of the cells are, from the apposition of their neighbours, irregular and somewhat angular in shape; here and there, however, we see one quite round, and these can scarcely be distinguished from the youngest Purkinjean vesi-

cles. In the latter, however, the nucleus looks rather more solid. The smallest Purkinjean vesicle which I saw was $\frac{6}{8000}$ths of an inch in diameter.

The yelk of the young eggs appears to possess no vitelline membrane; nor, though the boundary is perfectly distinct, has it any definite shape, but, apparently in consequence of the pressure put upon it by its neighbours, the outline which it assumes is very variable. As, however, it continually increases in size, it gradually comes to occupy the whole width of the egg-tube, and then assumes generally a more or less wedge-like shape, the Purkinjean vesicle occupying the thicker end. There are usually three or four egg-germs in this stage.

The two or three most advanced egg-germs approximated more or less to the form of the mature egg, and were darkened by the deposition of granules and small oil-globules.

Below the egg was some yellow matter, corresponding apparently to the so-called "corpora lutea" found in the egg-tubes of insects.

The mature egg is elongated, fusiform, about $\frac{9}{200}$ths of an inch in length, and enclosed in a tough, somewhat transparent chorion.

surface of the macula, forming a projection, and, indeed, sometimes appears to detach itself altogether from the macula. It is always quite clear and transparent, while the macula itself is turbid, though at this stage it again contains a clear space in its interior. I examined the Purkinjean vesicles of six full-grown eggs, but was unable to satisfy myself as to the normal state of their contents at this stage. All of them contained the large maculæ, which in some of them had the form of a hollow cap. Two of them had a second clear macula, about half as large as the first; and one contained a number of small vesicles. These changes may be compared with those which I have described as occurring in *Geophilus*.[1]

The yelk consisted, as usual, of a viscid substance, containing fine granules and oil-globules, varying up to $\frac{1}{1000}$th of an inch in diameter. Acetic acid acted in the usual manner on these tissues, and dissolved all the granules contained in the free nuclei (which I supposed to be embryonic Purkinjean vesicles), just as it does the true maculæ.

Dilute ammonia also dissolves the macula and the granules of the free nuclei.

The ovaries of *Lepisma* resemble those of *Machilis*. The testes of *Lepisma*[2] are short cylindrical bodies, opening by narrow vasa deferentia into one common, rather wide duct on each side. There are also two saccular, glandular organs, which lie one on each side of the middle line, between the sperm ducts, into which they apparently open, close to the external orifice.

Campodeadæ.

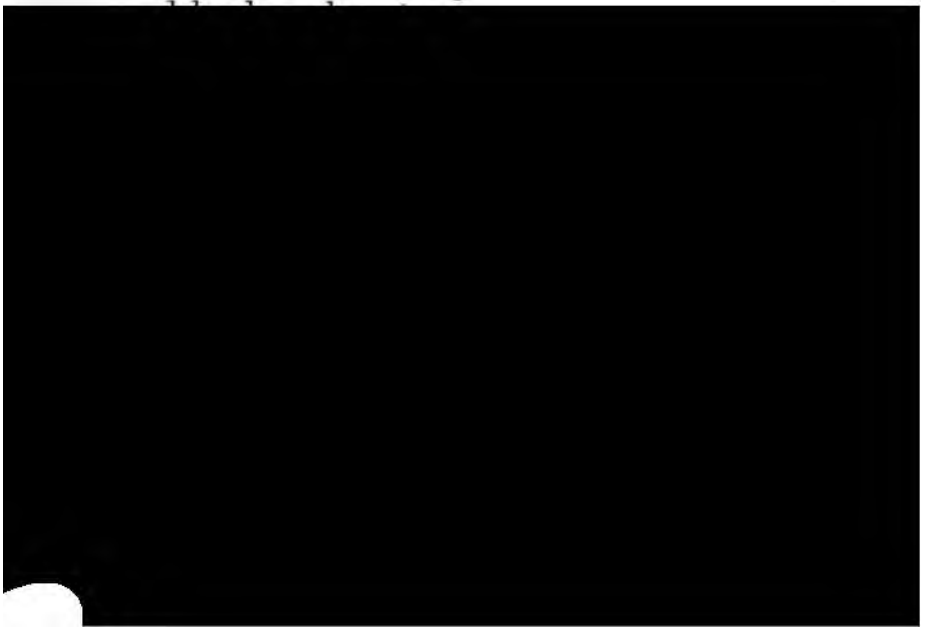
Body elongated, cylindrical. Antennæ multiarticulate. The first seven abdominal segments bear a pair of appendages on the under surface. Caudal appendages long, multiarticulate.

[1] 'Phil. Trans.,' 1861.
[2] 'Treviranus,' l. c., p. 16.

This interesting family contains two genera, *Nicoletia*, Gervais, and *Campodea*, Westwood. The former is most nearly allied to the *Lepismadæ*, having three caudal appendages and large palpi. Indeed, the structure of the mouth in *Nicoletia* is very different from that in *Campodea*. Unfortunately, however, Gervais gives no detailed description, and I have had no opportunity of myself examining either species of the genus. From Gervais' figure and Nicolet's description[1] the mandibles and maxillæ seem to be much less retracted than in *Nicoletia;* the maxillary palpi are elongate and 5-jointed; the labial palpi 4-jointed, If there is no mistake about these facts it will scarcely be possible to retain *Campodea* and *Nicoletia* in the same family, but I cannot help still feeling some doubt whether *Nicoletia* is a mature form; *Campodea*, as already mentioned, seems to me to be the representation of a form from which many other groups have been derived.

Campodea, Westwood.

Corpus elongatum, abdomine decemarticulato. Palpi minuti. Antennæ longæ, multiarticulatæ. Cerci



tinctum horizontale. Antennæ duæ capite duplo longiores, ad partem anticam capitis insertæ, multi- (ultra 13) articulatæ, submoniliformes articulo basali majori obconico setosæ. Os inferum mandibulis minutis planis latis apice 4-dentatis. Partes reliquæ oris deteritæ. Thorax e segmentis tribus proximis constans; segmento uno brevi nudo, 3-tioque multo longioribus et latioribus, singulo pari pedum instructo pedibus (fere dimidii corporis longitudine) e coxa, trochantere, femore, tibia et tarso articulato formatis. Abdomen 9 (quære 10) annulatum segmentis fere æqualibus et transversis, segmento basali subtus ad apicem utrinque appendiculo brevi lato, ovali plano exarticulato instructo segmentis sex proximis ad apicem utrinque seta brevi tenui pilosa instructo segmentoque anali setis duabus valdè elongatis setosis munito."

White.

Common in loose damp earth.

Switzerland, France, England.

This species appears to be that described by Linnæus under the name *Podura ambulans* in the 'Systema Naturæ,' ed. xii, though it is not the *P. ambulans* of the Fauna Suecica.

The abdomen has really ten segments.

Campodea fragilis, Meinert.

Campodea fragilis, Meinert. Natur. Tids., 1865, and Ann. and Mag. Nat. Hist., 1867.

"Nivea (vel lutea), densius pilosa.

"Caput æque longum ac latum.

"Antennæ longitudinem corporis dimidiam paululum superantes, sæpissime 18-20-articulatæ, articulo pænultimo brevi, ultimo longo sæpissime articulos duos vel très pænultimos longitudine æquante.

"Cerci fere longitudine abdominis, 11-14-articulati.

"Long. 5·5 millim."

Nicoletia, Gervais.

" Corpus elongatum, abdomine decemarticulato.

" Antennæ longæ, multiarticulatæ. Palpi maxillares elongati, 5-articulati. Palpi labiales 4-articulatæ. Cerci caudales tres, elongatæ."

Nicolet says that there are seven very small oval eyes on each side of the head, arranged in an oblique line, a little behind the antenna.

Nicolet has named two species of this genus, *N. geophila* and *N. phytophila*. He gives no description of the former in the 'Ins. Apt.' (vol. iii, p. 454), but refers to the 'Ann. Soc. Ent. France,' vol. xi, p. 48, where he gives a generic character, in which the peculiar structure of the mouth is omitted, but no specific characters are given for either species.

Nicoletia phytophila is described as—

" Blanc jaunâtre. Tête et corps ·004 en longueur."

This genus has not yet been found in England.

IAPYGIDÆ.

" Antennæ multiarticulatæ. Maxilla integra, falcata.

among the true *Thysanura* must then for the present be regarded as merely provisional.

Iapyx, Haliday.

"Antennæ longæ, multiarticulatæ, articulo ultimo parvo. Oculi nulli. Palpi biarticulati.

"Cerci breves, inarticulati, cornei, forcipis instar."

According to Meinert there are ten spiracles "situated in the side folds of the first ten rings." The digestive tube is straight, and, as in the COLLEMBOLA, there are no Malpighian vessels. The ovaries consist of a pair of wide tubes, opening at the back of the eighth abnormal segment. The ganglia are large and round; there are three thoracic ganglia, and one in each of the first eight abdominal segments.

As regards the feet Haliday says, "Unguiculi bini pares." Meinert, on the contrary, describes[1] and figures them as unequal, the lesser claw being attached (Pl. LXV, fig. 12) as in the COLLEMBOLA. Again, according to Haliday the anterior abdominal segments have no appendages; Meinert, however, discovered a rudimentary pair on each of the seven anterior segments.

Iapyx solifugus, Haliday.

Iapyx solifugus, Haliday. Trans. Linn. Soc., vol. xxiv.
— — Meinert. Nat. Tids., S. 3, vol. iii.

Pl. LXV, fig. 13.

About five lines in length; ivory white, semitransparent; the terminal segments of the abdomen and the forceps chestnut.

This interesting species has been found under stones in Algeria, Italy, Switzerland, and France, as far north as Paris. It has not yet been met with in Great Britain.

[1] 'Nat. Tids.,' p. 434.

Iapyx gigas, Brauer.

Iapyx gigas, Brauer. Wien. Zool. Botan. Gesells, 1869, p. 557.

Antennæ 50-jointed, sometimes a quarter, sometimes half the length of the body; the two basal segments cylindrical, the following ones rather thicker, spherical, the rest gradually tapering. The abdomen becomes gradually broader behind, the seventh segment being the broadest. The dorsal plates of the six first segments are rounded at the sides; the seventh is very convex at the sides, the posterior angle being produced into a strong point, which is somewhat inclined inwards; the eighth segment is one third shorter and somewhat smaller than the sixth, and has also the posterior angles produced, but straight; the ninth segment is only half as long as the eighth, the angles somewhat pointed. The first seven segments have at the sides and underneath short 3-jointed appendages, which point backwards. The tenth segment with the forceps is as long as the four preceding rings together; the forceps being scarcely shorter than the segment. The right arm of the forceps is much broader than the left; the basal half bears on the inner margin two strong teeth, and an

ment of the teeth differs from that of the other species. The seventh ring is not always so much expanded, and in these cases the animal is slenderer. The form of the antennæ above described is due perhaps to the manner in which the animal was preserved. The colour is yellowish-gray, the three last rings are horny, reddish-brown, the tips of the forceps very dark.

During life the other segments are white and soft; the body is clothed with fine scattered hairs, which are most numerous on the antennæ and on the posterior segments.

The length of the body without the antennæ is 23-26 millimètres.

Length of the antennæ 6-13 millimètres.

Length of the abdomen 15-17 millimètres.

Breadth of the seventh segment $2\frac{2}{3}$-4 millimètres.

Last segment and forceps 4-$5\frac{1}{4}$ millimètres.

Cyprus.

M. Humbert has also described[1] a species of this genus found in Mexico. It is considerably larger than the *I. solifugus*, and the antennæ have from forty-five to forty-eight segments. The forceps resembles that of the European species, but differs in details.

Lepismidæ.

Body elongate, covered with scales; antennæ long, multiarticulate; palpi long; abdomen 10-jointed, caudal appendages multiarticulate.

Lepisma, Linn.

Body covered with scales, flat; antennæ long, inserted between the eyes, which are small and distant. Nonsaltatorial.

[1] 'Rev. et Mag. de Zoologie,' 1868.

Lepisma saccharina, Linn.

Lepisma saccharina, Linn. Faun. Suec.
— — „ Syst. Nat.
— — Fabr. Ent. Sys.
Forbicina plana, Geoff. Ins. Env. Paris.
Lepisma semicylindrica, De Geer. Ges. d. Ins., vol. vii.
— *saccharina*, Müller. Zool. Dan. Prod.
— — Treviranus. Vermis. Schrift. vol. ii.
Machilis cylindrica, Lac. and Bois. Faun. Ent. Env. Paris.
Lepisma saccharina, Lucas. His. Nat. Crus. Ar. and Myr.
— — Temp. Trans. Ent. Soc., vol. i.
— — Gervais. His. Ins. Apt., vol. iii.
— — Burm. Hand. d. Ent.
— — Nicolet. Ann. Soc. Ent. France, 1847.
— — Lubbock. Trans. Linn. Soc., 1869.

Plate L.

Silvery white, with a yellowish tinge about the antennæ and legs.

Length $\frac{1}{3}$ of an inch.

Head free. Mesothorax and metathorax somewhat wider, but shorter, than the prothorax. Abdomen gradually tapering.

Eyes black, remote. Antennæ long, tapering; basal segment short, others numerous and still shorter; at some little distance from the base they

of each thoracic segment is a sort of flap, beautifully covered with scales. That of the prothorax is very large; the other two are smaller, particularly the one belonging to the metathorax.

The abdominal appendages are confined to the two posterior segments. They are represented, however, on the anterior ones by a group of stiff yellow setæ. There is moreover a second, similar group nearer to the median line, which appears to represent a second process, formed by a prolongation of the ventral margin of the penultimate segment.

Gervais[1] considers that these appendages should be compared to the branchial appendages in Neuroptera rather than to true legs; he observes, "Cette manière de voir, que nous avons proposée peu de temps après, rend également compte de l'absence de trachées déja constatée par plusieurs observateurs chez les véritables Thysanoures, c'est à dire, chez la famille des Lépismes." The branchial appendages of Neuroptera, however, are dorsal, while those of the Lepismidæ are ventral; moreover, in opposition to the above assertion, the Lepismidæ undoubtedly have tracheæ, although the system is not very largely developed. It seems to me curious that there should be any difference of opinion on this point, because, from the transparency of the creature, the tracheæ in the legs are visible without dissection. It is true that Treviranus[2] was unable to satisfy himself as to the presence of tracheæ; but I can only account for this on the hypothesis that he did not examine freshly killed specimens.

The egg-tubes and the formation of the ovum resemble those of Machilis, as already described.[3]

The posterior abdominal dorsal plate has a squarish termination.

Common throughout the greater part of Europe.

This is the only species which as yet has been found in Great Britain.

[1] 'Vermischte Schriften,' vol. i, p. 16.
[2] Suites à Buffon. 'Insectes Aptères,' vol. iii, p. 446.
[3] Ante, p. 209.

Lepisma annuliseta, Guer.

Lepisma annuliseta, Guerin. Icon. d. Reg. An.
— — Gervais. His. Ins. Apt., vol. iii.
— — Nicolet. Ann. Soc. Ent. France, 1847.
— — Lucas. His. Nat. des Crus. Arach. et Myr.

" Presque double du précédent (L. saccharina), argenté ; tête non tronquée en avant et terminée en pointe un peu saillante ; antennes un peu moins longues que le corps ; les soies caudales plus longues que dans le *L. saccharina ;* jaunâtre, annelée de brun.

" Des environs de Paris."

Lepisma lineata, Fabr.

Lepisma lineata, Fabr. Ent. Sys.
— *villata*, Guer. Icon. d. Regne. Anim.
— *lineata*, Gervais. His. Ins. Apt., vol. iii.
— — Nicolet. Ann. Soc. Ent. France, 1847.

" Antennes de la longueur du corps, ainsi que les filets latèraux de la queue ; filet intermèdiaire presque de moitié plus long.

" De Suisse et de France."

No._____

1. **Collector**. 2. **Date**. 3. **Locality**. 4. **Weather**. 5. **Habitat**: if parasitic, host; if saprophytic, soil or substratum. 6. **Mycelium**. 7. **Fruiting Body** or thallus, its manner of growth, appearance, substance, color. 8. **Stipe** (if present), position, diameter, length, shape, color, texture, interior, connection with pileus, base; **Veil**, ring, volva. 9. **Pileus** (if present), texture, color, shape, size, margin, juice, taste, smell. 10. **Hymenium**, distribution, form, color, margin, texture, attachment; lamellae, pores, etc. 11. **Spores**, color, sessile or stalked, form, size, surface, basidium, etc. 12. Additional remarks.

Lepisma parisiensis, Nicolet.

Lepisma parisiensis, Nicolet. Ann. Soc. Ent. France, 1847.

" Corpore obscuré argenteo capite flavescente fusco marginato, villosissimo. Antennis fuscis, longitudine corporis. Thorace lateribus nigro punctatis. Abdomine rufescente argenteo variegato, lateribus fusco nigroque maculatis, longitudinaliter maculis albis quadri lineatis. Pedibus palpisque flavescente cinereis, subnigro marginatis; setis tribus terminalibus, fulvis fortiter villosis annulatis, corporis longitudine.

" Long corp. 0·010. Lat. thor. 0·003.

" Habitat in domibus Lutecia, species rarissima."

This is very likely a foreign species recently domesticated in France.

Lepisma ciliata, Dufour.

Lepisma ciliata, Dufour. Ann Sci. Nat. 1 Ser., vol. xii.
— — Gervais. His. Ins. Apt., vol. iii.
— — Burm. Hand. d. Ent.
— — Nicolet. Ann. Soc. Ent. France, 1847.
— — Lucas. His. Nat. Crus. Ar. et Myr.

" Oblonga, subæque lata, supra griseo-rufescens, subtus argenteo-nitens, pilis radiato fasciculatis undique ciliata; setis analibus abdominis fere longitudine.

" Hab. rarissima sublapidibus in Hispaniâ.

" Long. 4-5 lin."

He adds, " La lépisme ciliée a une forme très différente de celle de la L. dorée (Lepismena aurea). Son corps est bien plus allongé, et son corselet est à peine un peu plus large que l'abdomen. Le bord antérieur de la tête a une barbe roussâtre. Les antennes sont glabres et d'un roux pâle, ainsi que les palpes; les maxillaires de ceux-ci sont assez saillans, et composés de cinq articles allongés, presque egaux entre eux, à l'exception du premier, qui est fort court. Les

labiaux ont la configuration propre au genre. Les bords du corselet et ceux de l'abdomen sont hérissés de poils fasciculés ; on voit sur la région dorsale de celui-ci des points noirâtres, disposés en série, et dont chacun offre à la loupe un double fascicule de soils, l'un couché, étalé en etoile, l'autre redressé. Les soies qui terminent l'abdomen sont à peu près égales entre elles, et de la longueur de celui-ci.

" Dans le mois de Novembre, 1811 and 1812, je trouvai cette Lépisme sous les pierres aux environs de Murviedro et de Moxente, dans le royaume de Valence. Je ne l'ai plus rencontré depuis. Celle que j'ai dessinée est une femelle ; c'etait une mère entourée de ses petits, qui etaient attroupés comme ceux du cloporte, et qui lui ressemblaient, à la grandeur près."

Lepisma ægyptiaca, Sav.

Lepisma ægyptiaca, Savigny. Des. de l'Egypt. Pl. i, Ins., fig. 7.
— — Lucas. His. Nat. Crus. Ar. et Myr.
— — Gervais. His. Ins. Apt., vol. iii.

" Corps étroit ; antennes plus longues que lui, hérissées de petits poils ; quelques poils assez allongés à la partie antérieure de la tête, près des antennes ; palpes longs, grêles, velus ; pattes également velues, mais à

rieurs et les côtés du thorax ; antennes beaucoup plus longues que le corps, ciliées ; des petits faisceaux de poils très-allongés placés en dessus et latéralement aux anneaux de l'abdomen ; soies terminales fort longues, surtout la médiane, ciliées.

" Long. 3 lignes."

Lepisma petitii, Guerin.

Lepisma petitii, Guer. Iconog. du regne animal. Exp. Ins. p. 10.
— — Lucas. His. Nat. Crus. et Myr.

" Le thorax est épais, avec l'abdomen rétréci brusquement en arrière ; les antennes sont de la longueur du corps, pâles, ainsi que les pattes ; les filets caudaux sont aussi de même longueur, pâles, annelés de brun ; le corps est noir, avec le bord postérieur de chaque segment argenté.—Cette espèce a été trouvée dans une boîte d'insectes qui arrivait du Sénégal."

Lepisma villosa, Fabr.

Lepisma villosa, Fab. Ent. Sys.
— — Gur. His. Ins. Apt., vol. iii.
— — Burm. Hand. d. Ent.
— — Nic. Ann. Soc. Ent. France, 1847.

" Fusca, cauda triplici villosa."

Habitat in China.

" Statura L. saccharinæ, at brevior et crassior. Caput villosum, albidum. Corpus ovatum, supra fuscum, subtus albidum. Cauda setis tribus valde villosis, intermedia longiore et subtus setulæ duæ brevissimæ, uti in L. saccharina. Pedes breves, albi."

Lepisma collaris.

Lepisma collaris, Fab. Ent. Sys.
— — Gerv. His. Ins. Apt., vol. iii.
— — Bur. Hand. d. Ent.

" Nigra, fascia collari anoque niveis, cauda triplici villosa.

" Hab. in Americæ meridionalis insulis.

" Statura et magnitudo omnino precedentis (villosæ). Antennæ longitudine corporis fuscæ, basi pallidæ. Caput albidum. Thorax scutis tribus latis: anteriore margine niveo fasciam constituente. Anus niveus, cauda triplici cinerea, villosa. Setulæ quatuor subcauda. Pedes pallidi."

Lepisma vittata, Fab.

Lepisma vittata, Fabr. Ent. Sys. Supplement.
— — Lac. et Bois. Faun. Ent. Env. Paris.
— — Lucas. His. Nat. Crus. Ar. et Myr.
— — Burm. Hand. d. Ent.

" Cauda trisetâ thorace membranaceo rotundo, abdomine lineato.

" Habitat in Italia.

" Statura et magnitudi *L. lineatæ*. Caput fuscescens antennis longis, pallidis. Thorax planus lateribus membranaceis, rotundatis, pallidis. Abdomen fuscum vittis quinque albidis, micantibus. Cauda pilis tribus villosis et subtus setulis aliquot: intermedia elongata. Pedes pallidi."

Les segments thoraciques sont sinués au bord postérieur et inégaux en longueur; le second est le plus court, mais diffère peu du troisième; le premier, qui est le plus long, reçoit la tête dans une échancrure peu profonde. Les segments abdominaux sont subégaux et légèrement relevés en gouttière sur leurs côtés. Enfin les filets terminaux sont bruns, hérissés de longs poils pâles et d'une longueur égale à celle du thorax.

"Rencontré une seule fois, sous les pierres dans les premiers jours de janvier aux environs d'Alger."

Lepisma Nicoletii.

Lepisma Nicoletii, Lucas. Rev. Zool. par la Soc. Cuv., Ann. 1846, p. 253.
— — „ Expl. Sci. de l'Algérie.

" L. ochracea squamis roseo-subviolaceo tinctis; antennis luteis, corpore longioribus, rubro annulatis; corpore, capite lateribusque piloso rubescente ciliatis; pedibus palpisque flavescente cinereo tinctis; setis terminalibus circiter corpori æqualibus, rubro pilosis, ultimis verticilliformibus.

" La couleur générale de cette magnifique espèce, dont la description qui va suivre est faite sur le vivant, est le jaune ocracé vif, plus foncé sur le milieu du prothorax et sur celui de la tête que sur le reste du corps. Les écailles reflètent un rose violacé métallique. La tête, large, tronquée antérieurement, attachée au thorax par un cou distinct, est ciliée de longs poils rouges; elle porte deux antennes plus longues que le corps, d'un beau jaune vif, annelées de brun rouge et couvertes de poils de cette dernière couleur. Le thorax, dont le deuxième segment est un peu plus long que le premier, et le troisième moitié plus court est bordé latéralement de courtes épines triangulaires, brunes, portant chacune au sommet un bouquet de trois ou quatre longs poils rouges et divergents. Les bords postérieurs de chaque

segment sont en courbe, et offrent chacun, près de leurs extrémités latérales, une petite échancrure lunuliforme, dont le côté convexe est cilié de longs poils rouges divergeant en éventail et le côté concave également cilié, mais de poils jaunes. Chaque extrémité latérale de bords postérieurs des segments abdominaux présente deux échancrures semblables; les deux intermédiaires font suite à celles du thorax; les autres sont rapprochées des bords latéraux de l'abdomen, et un peu plus petites. Les pattes, grisâtres à la base, d'un jaune sombre à l'extrémité, sont annelées de noir aux articulations. La dernière paire d'appendices latéraux est longue et d'un vert jaunâtre. Les filets caudaux, d'un beau jaune vif et annelés de rouge, sont hérissés de longs poils de cette dernière couleur, régulièrement disposés en verticilles; la longueur des filets est presque égale à celle du corps.

" Long. 11 millim. Larg. 3 millim.

" Cette belle et remarquable espèce, que je n'ai prise qu'une seule fois, en février, aux environs d'Oran, se tient sous les pierres, dans les lieux secs et arides."

Lepisma chlorosoma.

égaux en longueur, ont leurs angles postérieurs arrondis ; le premier reçoit la tête dans une échancrure concave, large et peu profonde ; une pareille échancrure dessine son bord postérieur ainsi que celui des deux segments suivants. La tête est d'un brun noirâtre uniforme ; les antennes plus courtes que le corps, d'un brun plus clair ; les palpes et les pattes jaunes. Les segments thoraciques sont postérieurement bordés de blanc vif et ceux de l'abdomen de vert opaque ; le cinquième segment abdominal offre deux taches blanches, quadriformes, allongées transversalement, et situées chacune près de l'angle antérieur en juxtaposition avec le bord postérieur du quatrième ; au milieu du bord antérieur du sixième sont deux autres taches également blanches et en quadrilatère allongé transversalement, mais rapprochées l'une de l'autre ; enfin deux gros points blancs, jumeaux et ronds, occupent le milieu du neuvième. Le bord postérieur du dixième, les filets caudaux et la dernière paire d'appendices latéraux sont d'un rouge brique vif et garnis de longs poils oranges. Dans cette jolie espèce, les filets sont courts et forts, ils n'atteignent pas en longueur le tiers du corps.

" Long. 4 millim. Larg. 2 millim.

" C'est sous les écorces des oliviers et des caroubiers que j'ai toujours rencontré cette jolie petite espèce, qui n'est pas très-rare ; environs d'Alger."

Lepisma quadri-lineata.

Lepisma quadri-lineata, Lucas. Rev. Zool. par la Soc. Cuv., Ann. 1846, p. 254.
— — „ Expl. Sci. de l'Algérie.

" L. antennis setisque fusco-flavescentibus, subtiliter nigro annulatis ; primis corpore longioribus ; ultimo rubiginoso, subtiliter, fusco punctato, suprà longitudinaliter rubro quadri-lineato ; pedibus palpisque nigris, subflavescente annulatis.

" Cette espèce, dont la description est faite sur un

individu conservé dans l'alcool, à beaucoup de rapports avec le *Lepisma Nicoletii* dont elle a exactement la forme et la grandeur ; sa tête est noire et portée sur un cou distinct ; les antennes, aussi longues que le corps, sont d'un brun jaunâtre, finement annelées de noir et garnies de poils fauves. Le thorax et l'abdomen, d'un jaune rouille, finement pointillés, de brun rouge, partant quatre lignes longitudinales et équidistantes, d'un brun rouge vif. Les bords latéraux du thorax sont dentelés, mais les dentelures n'offrent point de poils divergents au sommet. En général cette espèce offre peu de poils, mais cela est peut-être dû à un séjour trop prolongé dans l'alcool. Tous les segments du corps ont également leur bord postérieur en courbe concave, mais ici les échancrures latérales du *Lepisma Nicoletii* manquent et se trouvent remplacées par une large échancrure située au milieu de chaque bord postérieur. Les palpes et les pattes sont noires et annelées de jaune très-pâle à la base de chaque article, et les filets caudaux un peu moins longs que le corps, sont jaunes et irregulièrement annelés de noir.

" Cette espéce qui habite les environs de Bône et que j'ai prise sous les écorces des arbres vers les premiers jours de Novembre est assez rare ; je n'en ai rencontré que quelques.

tête, insérée dans une profonde échancrure du prothorax, est hérisée de longs poils gris et pointillée de brun. Le cou, très-apparent, est d'un brun rougeâtre ; les yeux noirs et les antennes, un peu moins longues que le corps, jaunes et finement annelées de brun. Le thorax, un peu plus large que l'abdomen, est déprimé, velu et irrégulièrement pointillé de brun ; son prothorax est beaucoup plus long que chacun des segments suivants et arrondi sur ses côtés. Les pattes sont d'un brun jaunâtre clair ; le fémoral des postérieures est beaucoup plus allongé que celui des deux paires antérieures. L'abdomen, déprimé, peu acuminé en arrière, à côtés presque parallèles, porte en dessus quatre lignes longitudinales de gros points noirs ; ceux des deux lignes intermédiaires sont beaucoup plus petits que ceux des lignes latérales ; ces points, au nombre de trente-deux, sont disposés quatre par quatre sur le bord postérieur de chaque segment abdominal, à l'exception du premier et du dernier, qui en sont privés. Sur chaque bord latéral des segments de l'abdomen se trouve un bouquet de poils assez longs brunâtres et divergents. Les soies caudales, d'une longueur égale à celles de l'abdomen, sont jaunâtres, largement annelées de brun pâle et hérissées de longs poils d'un gris brunâtre, disposés en verticelles. Cette espèce est en général très-velue.

" Long. 8 millim. Larg. 2 millim.

" Rencontré une seule fois sous les pierres, vers le milieu de janvier, sur les bords aux environs d'Alger."

Lepisma horrens, Nicolet.

Lepisma horrens, Nicolet, in Gay's Chili.

" Fusca, villosa, paululo squamosa ; abdomine depresso, villosissimo lateribus anoque nigrescentibus."

LEPISMINA.

Body flattened; more or less heart-shaped; scaly. Antennæ about as long as the body. Thorax much larger than the head or abdomen; caudal appendages short.

None of the species of this genus have as yet been met with in Great Britain.

Lepismina minuta.

Lepisma minuta, Müller. Zool. Dan. Prod.

Flava, cauda biseta.

Denmark.

Müller's *Lepisma minuta* has been placed by Burmeister, Gervais, and Nicolet, under the genus *Lepismina*. I confess, however, that I see no sufficient reason for this course, the description given by Müller being quite insufficient, even if correct.

Lepismina aurea.

que l'abdomen. Les appendices inférieurs sont ciliés, ainsi que les bords des plaque ventrales."

Lepismina Audouinii.

Lepismina Audouinii, Sav. Des. de l'Egypt. Ins., pl. i, fig. 9.
— — Lucas. His. Nat. Crus. Ar. et Myr.
— — Gervais. His. Ins. Apt., vol. iii.

"Long. 2, Lin. Larg. 1, Lig. $\frac{1}{4}$.

"La tête est tout-à-fait cachée par le prothorax, seulement on aperçoit en dessus les longs cils dont elle est hérissée; les antennes sont longues, ne dépassent pas cependant le corps; elles sont un peu plus fortes que dans l'espèce précédente et non ciliées; les palpes maxillaires sont assez robustes, ciliées et composées de cinq articles, dont le second est beaucoup plus fort que tous les autres; le premier est très-court, lisse; le second est un peu plus allongé, cilié et large à sa base; le troisième est très-large et très-convexe au côté interne; le quatrième est allongé, terminé en pointe, arrondi à sa base, très-large dans sa partie médiane, avec son bord extérieur très-convexe; tous ces articles sont ciliés, non-seulement en dessus, mais encore sur les bords externe et interne; le prothorax est très-large, arrondi antérieurement et sur les côtés, et couvert de petites écailles en dessus; le mésothorax et le métathorax sont étroits et également hérissés comme le prothorax de petites écailles; les segmens de l'abdomen sont écailleux et présentent en dessus, près du bord latéral (le dernier excepté), une épine assez allongée; leurs côtés latéraux sont également épineux; le dernier segment est beaucoup plus allongé que les autres et présente, à peu près à la naissance de chaque côté, une épine beaucoup plus forte que les autres; les soies caudales sont excessivement courtes, avec la médiane plus allongée que les latérales; elles sont toutes pourvues de longs cils; les pattes sont assez allongées, robustes, et présentent çà et là des cils forts, allongés.

—Elle habite la même localité que l'espèce précédente." From Egypt.

Lepismina Savignyi.

Lepismina Savignyi, Sav. Descrip. de l'Egypt. Ins., pl. i, fig. 10.
— — Lucas. His. Nat. Crus. Ar. et Myr.
— — Gervais. His. Ins. Apt., vol. iii.

" Long. 2, Lig. $\frac{1}{2}$. Larg. 1, Lig. $\frac{1}{4}$.

" Cette espèce est remarquable par la longueur de son prothorax, de son mésothorax et de son métathorax ; les antennes, qui sont finement ciliées, grêles, ne dépassent pas le corps par leur longueur ; les palpes sont grêles ; les pattes sont peu allongées, couvertes de longs poils ; la tête est large, arrondie, avec son bord antérieur couvert de poils ; le prothorax est très-large, non écailleux, avec son bord antérieur concave dans sa partie médiane, arrondi et hérissé de poils sur les côtés latéraux ; le mésothorax est un peu moins large, il en est de même du métathorax, tous deux sont non écailleux, avec leurs bords latéraux arrondis et ciliés, les segmens de l'abdomen sont lisses et diminuent de largeur jusqu'à la partie postérieure ; les premier, second, troisième, et quatrième offrent à leur bord postérieur de chaque côté, près du côté latéral, deux

Lepismina myrmecophilia.

Lepisma myrmecophila, Lucas. Rev. Zool. par la Soc. Cuv., Ann. 1846.
— — „ Expl. Sci. de l'Algérie.

"L. flavo-aurata, nitida; corpore brevi, anticè rotundato posticè acuminato; antennis pedibusque flavo-rubescentibus, ultimis brevibus, validis; caudâ triplici, brevissima.

"La couleur générale de cette espèce est le jaune doré très-brillant et uniforme, avec les antennes, les pattes et les filets terminaux de l'abdomen d'un jaune rougeâtre. Le thorax, presque aussi large que long, à ses trois segments sinués au bord postérieur; le premier très-grand, et d'une longueur égale à deux fois celle du troisième, est arrondi à sa partie antérieure, au bord de laquelle est une étroite, mais assez profonde échancrure destinée à recevoir la tête; celle-ci est courte, large, fusiforme et transverse; elle porte, comme tous les Lépismes, ses yeux sur ses extrémités latérales. Les antennes ont leurs deux premiers articles gros, courts et rouges; elles sont assez fortes et d'une longueur égale à celle de la tête et du corselet réunis. Les pattes sont courtes et fortes; l'abdomen, acuminé en arrière ou diminuant graduellement de diamètre de la base à l'extrémité, est terminé en dessous par trois filets fort courts, assez épais, et dont l'intermédiaire est en grande partie recouvert par le dernier segment abdominal, qui se termine en pointe émoussée. Les appendices latéraux du ventre ne sont visibles en dessus qu'aux deux avant-derniers segments, les autres segments les ayant très-courts et couchés longitudinalement sur leur surface. Enfin, les angles latéraux postérieurs, des sept premiers segments offrent chacun un bouquet de poils fauves, peu allongés et divergents.

"Long. 10 millim. Larg. 3 millim.

"Cette espèce, qui vit avec les fourmis et n'a été rencontrée nulle part ailleurs que dans les fourmilières,

appartient, ainsi que la suivante, à la division de Lépismines ; elle est surtout remarquable par le brillant et l'uniformité de cōuleur de ses écailles, qui sont d'un beau jaune doré, pâle et sans taches.

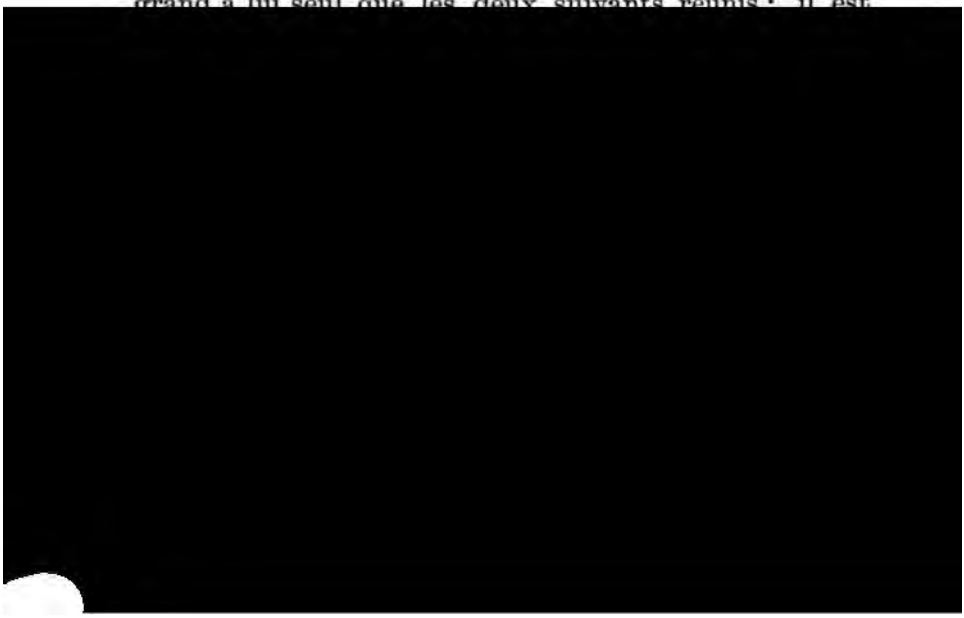
" Ce Lépisme, que j'ai pris pendant les mois de janvier et de février, habite les environs d'Alger ; il est très-agile, et c'est toujours dans les fourmilières que j'ai rencontré cette jolie espèce, qui n'est pas très-rare."

Lepismina gyriniformis.

Lepisma gyriniformis, Lucas. Rev. Zool. par la Soc. Cuv., Ann. 1846.
— — „ Expl. Sci. de l'Algérie.

" L. corpore fusco-æneo, anticè dilatato, gibboso, posticè acuminato, depresso, segmentis ad basim densè ciliatis ; antennis, palpis, pedibus, caudâque pallidè rubris.

" La tête et le corps sont d'un vert bronze foncé et brunâtre sur les côtés, jaunâtre et varié de rouge sur la longueur médiane. Le thorax, assez bombé, plus large que long, très-arrondi antérieurement et beaucoup plus dilaté transversalement que celui de l'espèce précédente, a son premier segment ou prothorax aussi grand à lui seul que les deux suivants réunis ; il est



"Comme dans le *Lepisma myrmecophila*, les filets terminaux sont très-courts et les antennes ne dépassent pas en longueur le thorax; mais ici tous les appendices latéraux sont visibles en dessus, et la dernière paire est aussi longue que les filets terminaux.

"Long. 4 millim. Larg. 2 millim.

"Ce n'est qu'aux environs d'Alger, sous les pierres, vers le milieu de janvier, que j'ai pris cette curieuse espèce; je ne l'ai rencontrée qu'une seule fois."

Lepismina formicaria, Von Heyden.

Atelura formicaria, Von Heyden. Ent. Zeitung, 1855.

Egg-shaped, yellow, shining.

Eyes inconspicuous. Antennæ half as long as the body, 11-jointed, setose; the segments cylindrical, those towards the apex diminishing in size, more egg-shaped and more sharply separated from one another. The second segment has towards the middle of the inner margin a bent tooth. The third segment is longer than the second and fourth. Maxillary palpi 5-jointed, the terminal segment elongated. Labial palpi 4-jointed, the terminal segment short and swollen.

Terminal segment of abdomen pointed, 4-toothed; the central appendage $\frac{1}{4}$, the lateral appendages $\frac{1}{8}$th, as long as the body, not distinctly jointed, sparsely covered with hair.

Length $1\frac{1}{2}$—2‴.

Germany. In nests of *Myrmica cæspitum*.

Von Heyden has proposed for this species a new generic division under the name of *Atelura*, principally on account of the antennæ, which possess only eleven segments.

MACHILIS, *Latreille*.

Body cylindrical, covered with scales; prothorax arched. Antennæ longer than the body, inserted in

front of the eyes, which are large and contiguous. Middle caudal filament much longer than the lateral ones.

Machilis polypoda.

Lepisma polypoda, Linn. Syst. Nat., ii, 1012.
— — Fabr. Ent. Sys., p. 62.
— — Muller. Zool. Dan. Prod.
Machilis brevicornis, Latr. Nouv. Ann. Mus., i, 79.
— — Lucas. His. Nat. Crus. Arach. et Myr.
Forbicina polypoda, Temp. Trans. Ent. Soc., vol. i, p. 92.
Machilis polypoda, Gervais. His. Nat. Ins. Apt., vol. iii, p. 448.
— — Nicolet. Ann. Soc. Ent. France, 1847.
— — Burm. Hand. d. Ent.

Plate LIII.

Brown, with metallic reflections.
Length $\frac{1}{2}$ an inch.
Woods and dry places.

I have only seen one specimen of this species, and that unfortunately in a bad condition. In Ireland, according to Templeton, it is very common. The head is small; the thorax is not distinct from the abdomen; the prothorax cylindrical; the mesothorax is enlarged and elevated; the metathorax is less raised, short and

about as long as the two basal. In Templeton's figure only the first two segments point forwards; and they are succeeded by a recurved many-jointed "whip." This does not at all agree with my specimen.

The lesser palpi are 3-jointed; the basal segment is shorter than the other two, which are nearly equal in length, the terminal one being somewhat swollen, though not so much so as in Templeton's fig. 1 *d*.

Geoffroy describes the corresponding organs of his *Forbicina teres saltatrix* as 2-jointed, another point in which it differs from *M. polypoda*.

The feet are biunguiculate.

I do not find it observed by previous writers that each of the four posterior legs bears an appendage on the basal segment, closely resembling the eight anterior ventral appendages. Their presence appears greatly to strengthen the argument of those who regard these appendages as rudimentary legs. It is moreover particularly interesting, if we remember that the peculiar genus *Scolopendrella* has a very similar pair of appendages attached between each pair of legs except the first.

In *M. polypoda* the anterior abdominal segment appears to want these appendages. In the following eight segments they are attached near the posterior margin, and are about equal in size, except the last, which is considerably larger than the rest. Between this last pair is a strong, straight, stiff appendage, which gradually tapers from the base, ending, however, abruptly. It is divided into about thirty subsegments, each with a whorl of stiff, short hairs.

M. maritima, Leach.

Petrobius maritimus, Leach. Edin. Encycl., ix, p. 77.
— — „ Zool. Miss., vol. iii.
Machilis maritima, Latreille. Nouv. Ann. d. Muscum, 1832.
Petrobius maritimus, Templeton. Trans. Ent. Soc., vol. i.
— — Webb and Berthelot. His. Nat. des Isles Canaries.

Petrobius maritimus, Gervais. Ins. Apt., vol. iii.
Machilis marilima, Nicolet. Ann. Soc. Ent. France, 1847.
— — Burm. Hand. d. Ent.

Plate LIV; Plate XVI, figs. 1—7.

P. nigricans, squamis auratis; pedibus flavicaulibus setis caudalibus albo-annulatis.

Brown, mottled, with bronze reflections; antennæ brown, unicolorous; caudal setæ with white rings.

Common on the rocky shores of England, Ireland, France, and (according to Webb and Berthelot) the Canary Islands.

Length ·5 of an inch.

These two species only have as yet been found in Great Britain.

Machilis cylindrica, Geof.

Machilis cylindrica, Geof. Ins. Env. Paris.
Lepisma thezeana, Fab. Ent. Sys. Supplementum.
Machilis cylindrica, Lacor-Boisd. Fauna. Ent. Env. de Paris.
— — Lucas. His. Nat. Crust. Ar. et Myr.
— *annulicornis*, Burm. Hand. d. Ent.
— — Gerv. His. Ins. Apt.

" La couleur de celle-ci est plus foncée que celle de la précédente. Son corps est presque cylindrique, au lieu

que le précédent, mais bien plus rarement ici. Il y a quelques provinces où il est très-commun."

Machilis fasciola, Nicolet.

Machilis fasciola, Nicolet. Ann. Soc. Ent. France, 1847.

The following is Nicolet's description of this species:

"Long. 0·010. Thorax d'un jaune bronzé sombre varié de brun noirâtre, une tache longitudinale en forme de gobelet et d'un blanc argenté, occupe le milieu du prothorax; cette tache se prolonge jusqu'au milieu du mésothorax, où elle s'oblitère pour se retrouver sous forme de ruban, large, droit, à côtés latéraux exactement parallèles sur toute la longueur médiane de l'abdomen. Tout le reste de l'abdomen est d'un bronze verdâtre sombre; une ligne transversale d'un vert doré, couvre le bord postérieur de chaque segment, et donne à la surface dorsale une apparence scalaire. Enfin deux lignes longitudinales et parallèles de pétits points noirs, situés au milieu de la bande argentée, complètent le dessin de l'abdomen, dont les filets terminaux sont bruns sans annelures.

"Le milieu du bord postérieur du mésothorax et du métathorax est d'un jaune vif entouré de rouille. Les pattes, la base des antennes et les palpes maxillaires sont jaunâtres; les tarses noirs; les antennes également noires, mais annelées de blanc.

"C'est probablement cette espèce que MM. Boisduval et Lacordaire regardent comme une variété du *Machilis annulicornis* ('Faune Entom. des Envir. de Paris'). Indépendamment de la couleur, elle en diffère cependant par la forme du prothorax, dont le bord antérieur est plus profondément creusé, avec ses angles latéraux un peu recourbés du côté externe, tandis que dans l'*annulicornis* c'est le contraire. Les filets terminaux manquent aussi des anneaux blancs que l'on observe dans le *Machilis annulicornis*.

"Cette espèce se trouve en France et en Suisse."

Machilis variabilis, Say.

Machilis variabilis, Say. Jour. Acad. Philadelphia, 1821.
— — Lucas. His. Nat. des Crus. Ar. et Myr.
— — Gervais. His. Ins. Apt.
— — Nic. Ann. Soc. Ent. France, 1847.

Superior caudal process more than double the length of the others; false feet bisetous at tip; colour cinereous or iridescent varied with black.

"Inhabits North America.

"Cabinet of the Academy.

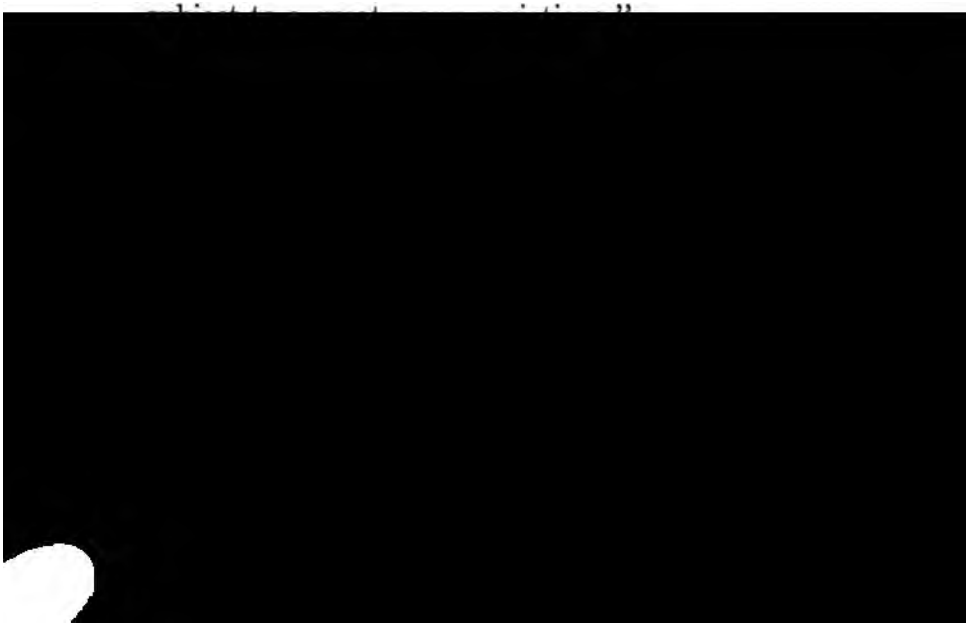
"Body above cinereous, somewhat iridescent, varied with black; gibbous portion of the body not differently coloured; a more or less whitish vitta; false feet white, hirsute, setaceous at tip, superior caudal process more than double the length of the inferior ones.

"Var. *a*. Body above unicolour, destitute of the white dorsal vitta.

"Var. *b*. Body ferruginous, with dusky lateral spots.

"Var. *c*. Body with several snowy spots each side.

"A common insect in many humid places, probably in almost every temperate part of North America. We observed it as far south as East Florida. It is



Machilis vittata, Burm.

Machilis vittata, Burm. Hand. d. Ent.
— — Gervais. His. Ins. Apt.
— — Nic. Ann. Soc. Ent. France, 1847.

"Aurichalcea, squamulis fuscis intermixtis; abdomine utrinque vitta unicolori, fusco marginata; palpis setisque albo-annulatis, breve pilosis."

Long. Corp. 4‴.

Carolina.

Machilis bimaculata, Lucas.

Machilis bimaculata, Luc. Rev. Zool. par la Cuv., Ann. 1846.
— — „ Expl. Sci. de l'Algérie.

"M. antennis setisque corpore brevioribus, flavescente fusco annulatis; corpore omninò rufescente; mesothorace duabus maculis oculiformibus cæruleis maculato; pedibus pallidè cinereo annulatis; oculis nigrescentibus.

"Cetté espèce, dont les antennes atteignent a peine en longueur celle de la moitié du corps, est entièrement d'un jaune rougeâtre métallique; son prothorax, beaucoup plus étroit que le mésothorax, est profondément échancré pour recevoir la tête; très-bombé et un peu acuminé en arrière, il est à son tour enclavé dans une échancrure du mésothorax, dont les côtés, se prolongeant antérieurement, l'entourent en grande partie. Le mésothorax, également très-bombé, porte, près de chacun de ses angles postérieurs, une tache oblongue, oculiforme, d'un bleu pâle, entourée de brun foncé; du bord antérieur de ce segment à l'extrémité de l'abdomen, a sa moitié antérieure plus dilatée que la postérieure, et porte trois lignes longitudinales parallèles peu apparentes, brunes, également espacées, mais dont les latérales ne descendent que jusqu'à la moitié du dos. Les yeux sont noirs; les antennes et les filets caudaux sont jaunes et annelés de brun. Les palpes maxillaires jaunes; les pattes, plus pâles que le corps, sont annelées de gris. Dans cette espèce,

la longueur des soies latérales qui terminent l'abdomen est exactement la moitié de celle de la soie médiane.

" Long. 10 millim. Larg. 2 millim."

M. Lucas only met with this species once.

Machilis acuminithorax, Lucas.

Machilis acuminithorax, Lucas. Rev. Zool. par la Soc. Cuv., Ann. 1846.
— — „ Expl. Sci. de l'Algérie.

" M. corpore setisque fuscoflavescente tinctis ; antennis, palpis, pedibusque flavescente rubiginoso maculatis ; antennis corpore longioribus ; thorace acuminato, anticè biemarginato, setis terminalibus rubiginoso annulatis ; occulis nigrescentibus.

" La description de cette espèce étant faite sur un individu conservé dans l'alcool, et par conséquent dépourvu d'écailles, elle ne peut porter que sur les caractères spécifiques indépendants de la couleur véritable. Le thorax, dont le premier segment est presque aussi long que le second, a sa partie la plus large à l'extremité postérieure, c'est-à-dire au mésothorax. Celui-ci est très-court, arrondi sur les côtés, et droit à son bord postérieur. Le métathorax, du double plus long, s'acumine insensiblement en s'arrondissant

brun jaunâtre pour le corps et les soies caudales; celles-ci sont en outre finement annelées de rouille, les antennes, les palpes et les pattes sont d'un jaune pâle, pointillé et maculé de rouille, mais seulement à la base pour les antennes.

" Rencontré sous les pierres humides, vers les premiers jours de janvier, dans les environs d'Alger.

" Long. 20 millim. Larg. 2 millim."

Machilis thoracica, Lucas.

Machilis thoracica, Lucas. Rev. Zool. par la Soc. Cuv., Ann. 1846.
— — „ Expl. Sci. de l'Algérie.

" M. corpore flavofuscescente maculato; thorace dilatato; antennis, palpis, pedibusque flavescentibus, immaculatis, setis terminalibus fusco annulatis.

" Cette description est faite sur un individu conservé dans l'alcool.

" Le thorax, très-dilaté, a ses premier et troisième segments très-courts; le premier est en outre très-étroit, profondément échancré pour recevoir la tête, et inséré dans une échancrure peu profonde du mésothorax; celui-ci est arrondi sur les côtés, et sinué à son bord postérieur. La tête, terminée antérieurement par une pointe aiguë et noire, est d'un jaune très-pâle et porte quatre points noirs, disposés comme dans le Machylis acumini-thorax. Les yeux sont bruns; les palpes, les pattes et les antennes sont d'un jaune pâle uniforme; celles-ci sont un peu moins longues que le corps. La soie caudale intermédiaire est d'une longueur égale à deux fois celle des soies latérales; elles sont brunes et finement annelées de brun plus foncé. Le corps, dépourvu d'écailles, est d'un jaune brunâtre pointillé de brun au milieu du bord postérieur de chaque segment.

" Ce Machyle habite les environs d'Oran, où je l'ai pris une seule fois sous les pierres dans les derniers jours de décembre.

" Long. 9 millim. Larg. 2 millim."

Machilis fastuosa, Lucas.

Machilis fastuosa, Lucas. Rev. Zool. par la Soc. Cuv., Ann. 1846.
— — Expl. Sci. de l'Algérie.

"M. capite, palpis antennisque rubroflavescente tinctis; antennis corpore brevioribus, fusco annulatis; corpore angustato, elongato; squamis, vel luteis, vel cæruleis, vel violaceo metallicis; abdomine fusco nigroque maculato; setâ intermediâ elongatâ, fuscâ; lateralibus brevibus, flavescentibus.

"Cette jolie espèce a le corps étroit, allongé et couvert d'écailles chatoyantes, variant du jaune au rouge vif, au bleu et au violet métalliques. Le prothorax, presque aussi long que le segment suivant, est biéchancré antérieurement; ses côtés sont peu recouverts par les prolongements du mésothorax; il est ainsi que le second segment, jaune varié de rouge au milieu, et bleu varié de vert sur les côtés. Le mésothorax est assez court profondément échancré postérieurement, et violet varié de jaune; cette couleur est aussi celle des deux premiers segments de l'abdomen; les trois suivants sont d'un jaune, vif au milieu et variés de violet et de vert sur les côtés; les sixième et huitième ont leurs côtés couverts d'une large tache quadriforme

jaune sombre, ainsi que les appendices latéraux du ventre, que sont tous très-apparents. Cette espèce, remarquable par le brillant et la variété de ses couleurs, a le thorax très-gibbeux, mais à peine plus large que l'abdomen.

" Long. 7 millim. Larg. 1 millim."

Machilis pallipes, Lucas.

***Machilis palipes*, Lucas. Expl. Sci. de l'Algérie.**

" M. corpore pedibusque flavescentibus ; antennis setisque fuscoflavescente annulatis ; abdomine subacuminato, fusco maculato ; oculis nigrescentibus.

" La description de cette espèce est faite d'après un individu conservé dans l'alcool.

" La couleur générale de ce Machyle est le jaune pâle, teinté de brun au corps très-pâle et un peu verdâtre aux pattes.

" Dans cette espèce, le corps, un peu dilaté au mésothorax, diminue insensiblement de diamètre du métathorax au dernier segments de l'abdomen dont la largeur égale à peine le tiers de celle du premier segment abdominal. Le prothorax, assez court, presque parallèle, offre une échancrure arrondie à l'insertion de la tête, celle-ci est très-courte, arrondie antérieurement en pointe obtuse. Les yeux, ovales et obliquant l'un vers l'autre, sont à peine conjoints, et noirs. Les antennes, un peu plus courtes que le corps, sont finement annelées de brun. Enfin les filets caudaux, dont l'intermédiaire est un peu plus du double plus long que les latéraux, sont irrégulièrement annelés de brun foncé. Le bord postérieur des segments abdominaux est finement pointillé de rouille ; chaque segment porte en outre une petite tache latérale de la même couleur, et disposée longitudinalement à chaque extrémité de la bordure postérieure.

" Long. 8 millim. Larg. $1\frac{1}{2}$ millim."

Machilis crassicornis, Lucas.

Machilis crassicornis, Lucas. Rev. Zool. par la Soc. Cuv., Ann. 1846.
— — „ Expl. Sci. de l'Algérie.

"M. omnino flavescens; antennis inflatis, fusco annulatis, corpore brevioribus; mesothorace longiore duobus segmentis sequentibus; abdomine segmentis inæqualissimis, setis terminalibus fuscis, corpore brevioribus.

"La description de cette espèce est faite sur un individu conserve dans l'alcool. La couleur générale est le jaune paille. Le corps est étroit, allongé, subcylindrique. Le deuxième segment thoracique, plus long que les deux autres réunis, est très-arrondi postérieurement; ses côtés sont presque droits et parallèles; ils se prolongent légèrement sur les côtés du prothorax; celui-ci est biéchanchré a l'insertion de la tête, et courvert, ainsi que les deux segments suivants, de points rubigineux sur son bord postérieur. La téte, courte, arrondie antérieurement, porte des antennes beaucoup moins longues que le corps, largement annelées de brun sur une partie de leur longueur et très-renflées et fusiformes près de leur base. Les

Machilis rupestris, Lucas.

Machilis rupestris, Lucas. Rev. Zool. par la Soc. Cuv., Ann. 1846.

"M. capite griseo-cinereo, utrinque griseo-bivittato; palpis griseo-cinerescentibus, antennis griseo-cinereis; corpore suprà griseo-cinerescente, griseo-fusco maculato, marginibusque griseo-punctatis; pedum primis articulis flavo sordidis, duobus ultimis griseo-cinerescentibus fortiterque fusco annulatis; corpore infrà fusco; setis breviusculis, albo subgrisescentibus fortiterque fusco annulatis.

" La tête est d'un gris cendré, ornée de chaque côté de deux bandes longitudinales, placées un peu obliquement, et qui sont d'un gris foncé. Les palpes sont d'un gris cendré clair, assez fortement annelés de brun foncé. Les antennes sont d'un gris cendré. Tout le corps en dessus est d'un gris cendré clair, avec les segments maculés de chaque côté de points d'un gris brun, placés parallèlement, à l'exception cependant du dernier segment, qui n'est qu'unimaculé; les parties latérales sont d'un gris cendré blanchâtre, tachées de points d'un gris foncé, qui, par leur réunion et répétés sur chaque segment, forment deux bandes longitudinales; les points qui forment la bande inférieure sont beaucoup plus distants que ceux qui forment la bande supérieure. Les pattes, à premiers articles d'un fauve sale, avec les deux derniers d'un gris cendré clair, sont fortement annelées de brun foncé. Tout le corps en dessous est d'un brun foncé. Les filets caudaux sont d'un blanc légèrement grisâtre et assez fortement annelés de brun. Cette espèce, à demarche excessivement vive, est assez abondamment répandue sur les rochers du Djebel Mausourah et du Koudiat-Ati; elle semble se plaire beaucoup au soleil, car ce n'est que pendant que celui-ci darde ses rayons sur les rochers, que j'ai toujours trouvé ce joli Machilis; je ferai aussi remarquer que cette espèce est difficile à apercevoir à cause de sa couleur, qui a la plus grande analogie avec celle des roches sur lesquelles on la recontre.

" Long. 11 millim. Larg. $\frac{2}{4}$ millim."

APPENDIX.

ESSAY ON THE SCALES OF THE COLLEMBOLA AND THYSANURA.

By Joseph Beck.

The great interest which has for many years been taken by microscopists in the scales of this class of insects, and the confusion which has existed as to the particular scale belonging to an individual species, has induced me to avail myself of the kind courtesy of Sir John Lubbock, Bart., to add to his valuable work on the Collembola and Thysanura a few words in description of the scales of the scale-bearing genera in this group, whilst, at the same time, I gladly embrace the opportunity of performing a tribute of affection to the memory of my late brother, Richard Beck, in superintending the publication of drawings of the scales of most of the species, executed by his own hand with great care, and admirably transferred upon stone by my relative, A. T. Hollick.

I enter with some diffidence upon a description of the structure of the scales of this class of insects, because I am aware that the attention of many of our most astute observers has been directed to the subject, and yet they have not settled the matter; I, therefore, can hardly expect to be more fortunate.

In describing the scale of each species I have given

a definition of the appearance produced by direct light, used in the simplest and purest manner, viz. with the Achromatic Condenser and parallel rays from a Mirror or Right-Angle Prism, and have necessarily omitted any allusion to the varied appearances to be produced by changing the direction or character of the light, although I have used these plans in determining structure, my object being to give such a description as may enable the observer to identify the particular species. My definitions of structure may clash with the views of some observers; they have been determined after careful observation and after many experiments.

I am convinced that the scales consist of two membranes; I have seen them partially separated. I have satisfied myself that the two exposed surfaces are totally dissimilar; that in all cases the under surface, or that nearest the body of the insect, is corrugated; that in all cases the upper surface is much less uneven, and in many is so slight in its irregularities that it may be described as smooth, whilst I attribute the beaded appearance, so often spoken of and so easily produced, as due to the combination of the external corrugated structure of the lower membrane and the internal structure of the upper membrane.

high magnifying power display the same structure as the larger species, and this may also be said of *Beckia argentea*, which, although somewhat thinner, is very similar in structure to *B. albinos*.

I had thought of adding an illustration of the appearances produced on the same scale by variations in the direction and character of the illumination; also one of the effect produced by placing two ribbed membranes over one another at an angle; also one showing the result of running moisture along the corrugations in the under surface of the scale; but illustrations of these experiments hardly come within the compass of a work such as the present, the object of which is to enable observers to identify the several species.

Plate LXVII.

Tomocerus longicornis.

Scale.—Dark continuous compound striæ, lines or corrugations, parallel to the pedicle; clearly defined cross striæ between, and at right angles to the longitudinal ones; a tendency to broad striæ radiating from the pedicle; under surface of scale deeply corrugated from pedicle to apex; upper surface of scale free from all corrugations, smooth; cross striæ due to structure between the superposed membranes. Under a power of 4000 diameters an appearance of beads between the longitudinal striæ is readily obtained; this is not the structure, but due to illumination.

Plate LXVIII.

Tomocerus plumbeus.

Scale.—Dark continuous compound striæ, lines or corrugations, parallel to the pedicle; indications of cross striæ between and at right angles to the longitudinal ribs; broad striæ radiating from the pedicle;

under surface of scale deeply corrugated from pedicle to apex; upper surface nearly flat, slightly undulating towards the pedicle, producing the appearance of radiating striæ; cross striæ due to structure between the superposed membranes. Under a power of 4000 diameters an appearance of cross hatching is obtained on the main longitudinal ribs.

Plate LXIX.

Templetonia crystallina.

Scale.—Irregular striæ or corrugations nearly parallel to the pedicle, broken up by alternate lighter and darker portions, giving an indication of separate "notes of exclamation" markings under direct achromatic illumination, each darker portion with a bright nucleus; under surface of scale irregularly corrugated from pedicle to apex; upper surface slightly undulating, the irregular breaking up of the longitudinal markings due to structure between the superposed membranes.

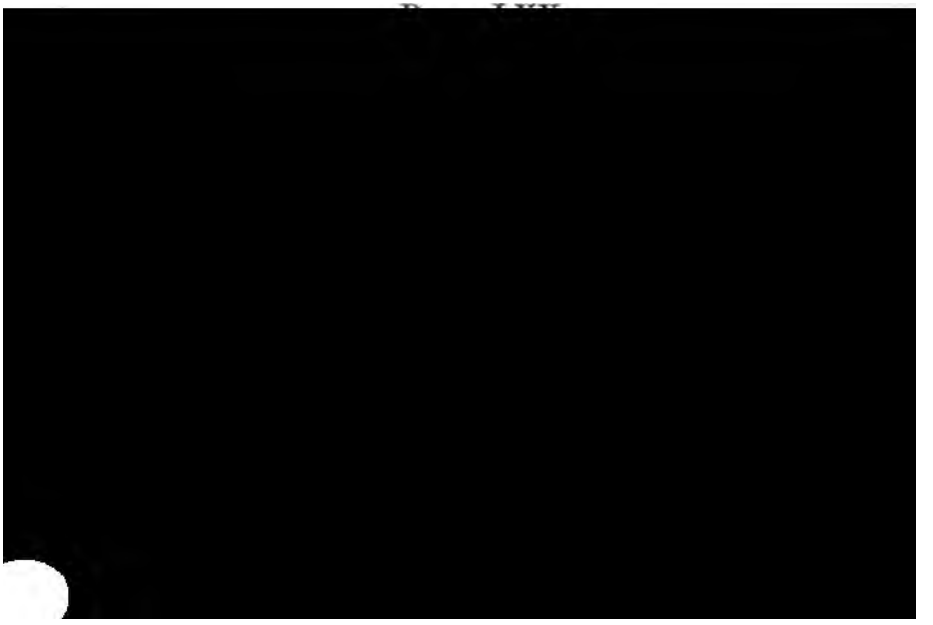


PLATE LXXI.

Seira Buskii.

Scale.—Irregular striæ nearly parallel to the pedicle, broken up into separate "notes of exclamation" markings, markings very irregular in size and shape, those nearest the pedicle being one half the length of the scale, decreasing in size to the apex, where they are very small; an indication of striæ radiating from near the pedicle; appearance due to deep corrugations on the surface of the under membrane, undulations on the external surface of upper membrane, and structure between superposed membranes.

PLATE LXXII.

Beckia argentea.

Scale.—Structure similar to that of *B. albinos;* markings not quite so distinct; scale thinner.

Beckia albinos.

Scale.—Irregular longitudinal striæ, broken up into "notes of exclamation" markings, each marking showing at the end furthest from the pedicle a brilliant nucleus of white light, markings very faint near the pedicle; appearance due to delicate corrugations on the outer surface of the under membrane and structure between the superposed membranes.

PLATE LXXIII.

Lepidocyrtus curvicollis.

Test Scale.—Irregular striæ or corrugations from pedicle to apex, broken up into large well-defined separate "notes of exclamation" markings, markings

very black, with a light bright ridge down the centre of each; appearance due to irregular corrugations on the outer surface of the under membrane, slight undulations on the outer surface of upper membrane, and to structure between the superposed membranes.

PLATE LXXIV.

Lepidocyrtus curvicollis.

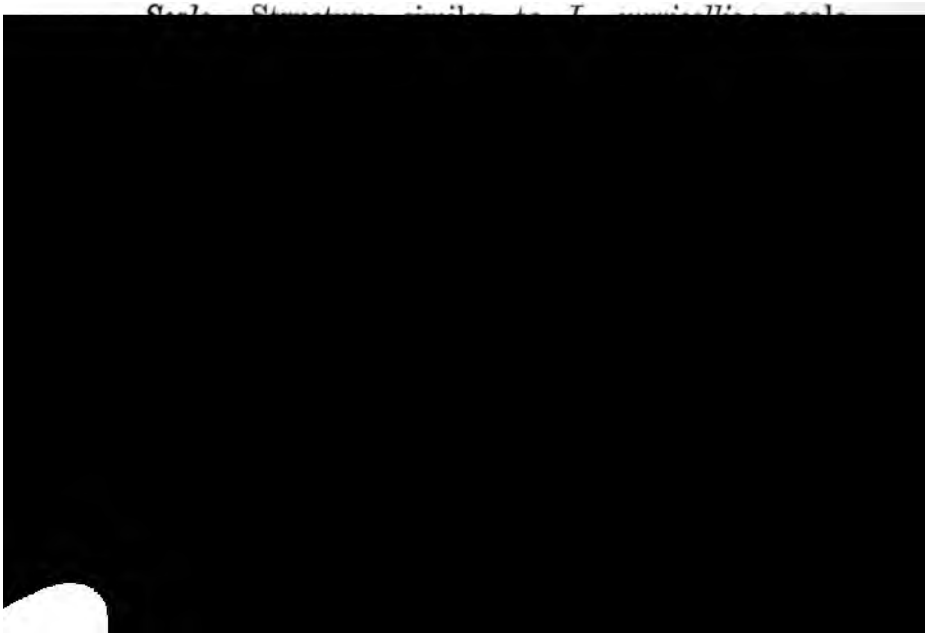
Ordinary scale.

Appearance somewhat similar to that shown in "the test scale;" markings smaller, nearer together, not so sharply defined; the bright ridge on the top of each marking not nearly so prominent; scale smaller and thinner.

Lepidocyrtus lignorum.

Scale.—Structure similar to *L. curvicollis;* scale much smaller and thinner; markings much less distinct.

Lepidocyrtus gibbulus.



L. æneus.

Scale not examined.

Lepidocyrtus purpureus.

Scale. — Structure similar to *L. violaceus;* scale rather thinner and smaller; markings more difficult to resolve.

PLATE LXXVI.

Lepisma saccharina.

Scale.—From twenty to twenty-six strongly marked lines parallel to pedicle; marginal lines broken up into an oval-beaded appearance by the intersection of lines radiating from the pedicle; external surface of under membrane, well defined straight corrugations from pedicle to apex; outer surface of upper membrane, corrugations radiating from pedicle, deeper towards the pedicle than at the apex.

PLATE LXXVII.

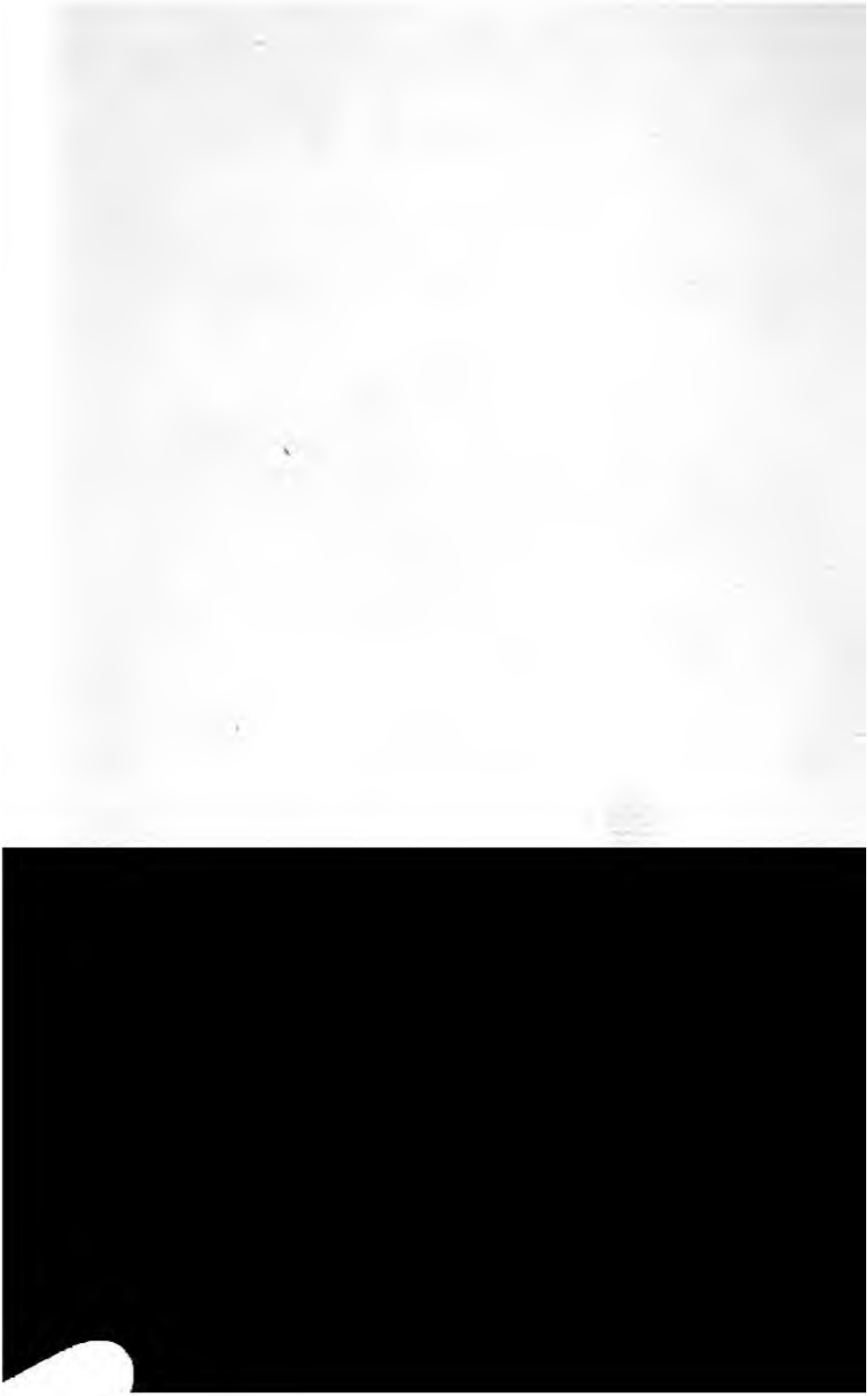
Machilis polypoda.

Scale. — From eighteen to twenty-four strongly marked compound ribs parallel to pedicle; well defined cross markings between and at right angles to main ribs; external surface of under membrane, straight longitudinal corrugations; external surface of outer membranes, smooth nearly flat, indications of undulations near to and radiating from, pedicle; cross lines due to structure between the superposed membranes.

PLATE LXXVIII.

Machilis maritima.

Scale.—Same structure as *M. polypoda;* scale longer in proportion to width; the longitudinal ribs not so numerous, varying from twelve to fifteen.



DESCRIPTION OF THE PLATES.

PLATE

I.—*Smynthurus viridis* × 30.
II. — *fuscus* „
III. — *luteus* „
IV. — *pallipes* „
V. — *Bourletii* „
VI. — *niger* „
VII. — *aureus* „
VIII.—*Papirius fuscus* „
Fig. 1. Seen from above.
2. „ below.
3. „ the side.
IX.—*Papirius ornatus* × 30.
X. — *nigromaculatus* „
XI. — *polypodus* „
XII.—*Orchesella cincta* „
XIII. — — „
XIV. — — „
XV. — *villosa* „
XVI. — — (under side) × 30.
XVII.—*Tomocerus longicornis* × 15.
XVIII. — — (young) × 30.
XIX. „ *plumbeus* × 30.
XX.—*Templetonia crystallina* „
XXI.—*Seira domestica* „

PLATE

XXII.—*Seira Buskii* × 30
XXIII.—*Beckia argentea* ,,
XXIV. — *albinos* ,,
XXV.—*Lepidocyrtus curvicollis* ,,
XXVI. — *lignorum* ,,
XXVII. — *gibbulus* ,,
XXVIII. — *violaceus* ,,
XXIX. — *æneus* ,,
XXX. — *purpureus* ,,
XXXI.—*Degeeria nivalis* ,,
XXXII. — *annulata* ,,
XXXIII. — *lanuginosa* ,,
XXXIV. — *Nicoletii* ,,
XXXV. — *cincta* ,,
XXXVI.—*Isotoma viatica* ,,
XXXVII. — *aquatilis* ,,
XXXVIII. — *anglicana* ,,
XXXIX. — *grisea* ,,
XL.—*Achorutes armatus* ,,

Fig. 1. Back view.

PLATE

XLVI.—*Lipura fimetaria* × 30

XLVII. — *maritima* „

Fig. 1. Seen from above.
2. Eye.

XLVIII.—*Anoura muscorum* „

Fig. 1. Seen from above.
2. „ below.

XLIX.—*Anoura granaria* „

L.—*Campodea staphylinus.*

LI.—*Iapyx solifugus* × 8.
After Meinert.

LII.—*Lepisma saccharina* × 6.

LIII.—*Machilis polypoda* × 4.

LIV. — *maritimus* „

LV.

Fig. 1.	*Smynthurus viridis.*	Antenna	× 60
2.	— —	Eyes	× 60
3.	— —	Spring	× 20
4.	— —	Anterior foot	×125
5.	*Papirius* —	Antenna	× 60
6.	— —	Eyes	×120
7.	— —	Spring	× 30
8.	— —	Anterior foot	×125
9.	*Orchesella cincta.*	Antenna	× 20
10.	— —	Eyes	×120
11.	— —	Spring	× 50
12.	— —	Foot	×120
13.	*Degeeria Nicoletii.*	Antenna	×120
14.	— —	Eyes	×255
15.	— —	Spring	× 50
16.	— —	Foot	×255

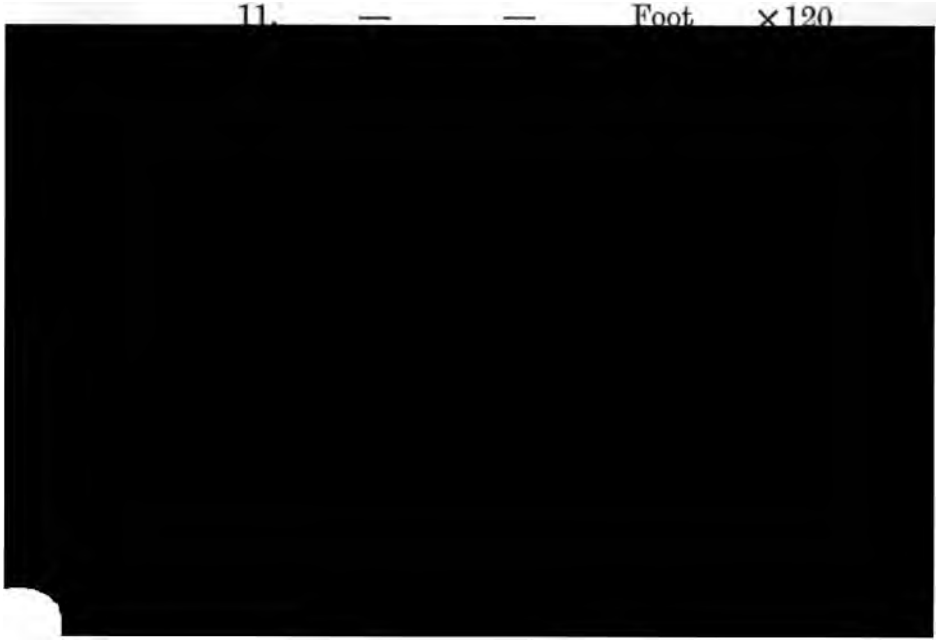
PLATE

LV.—(*continued*).

Fig. 17.	*Isotoma aquatilis.*	Antenna	× 70
18.	— —	Eyes	×120
19.	— —	Spring	× 50
20.	— —	Foot	×120
21.	*Lepidocyrtus lignorum.*	Antenna	× 60
22.	— —	Eyes	×120
23.	— —	Spring	×120
24.	— —	Foot	× 60

LVI.

Fig. 1.	*Seira domestica.*	Antenna	× 30
2.	— —	Eyes	×130
3.	— —	Spring	× 15
4.	— —	Foot	×120
5.	*Beckia albinos.*	Antenna	× 50
6.	— —	Spring	× 35
7.	— —	Foot	×225
8.	*Templetonia crystallina.*	Antenna	× 60
9.	— —	Eyes	×210
10.	— —	Spring	× 60
11.	— —	Foot	×120



PLATE

LVI—(*continued*).

Fig. 24. *Lipura fimetaria.* Antenna × 50
25. — — Foot ×125
26. — — Post antennal appendage ×250
27. *Anoura muscorum.* Antenna × 40
28. — — Eyes ×120
29. — — Foot ×120

LVII.—Section of *Smynthurus fuscus*, × 125, with the spring extended, to show the position and attachments of the muscles.

i. The ventral tube.

x. The catch.

LVIII.—Ditto ditto with the spring retracted.

The letters refer to the corresponding parts.

LIX.—Section of posterior abdominal segments of *Tomocerus longicornis*, side view, × 125, to show the position and attachments of the muscles.

LX. — Ditto ditto to show the position and arrangement of the outer muscles, which are concealed in the preceding illustration.

LXI.—Ventral surface of the posterior abdominal segments of ditto ditto.

LXII.

Fig. 1. Outline of a mutilated antenna of *Orchesella cincta*, 11 April, × 60.

2. The same, after a moult, 12 April, × 60
3. „ „ 19 „ „
4. „ „ 8 May „

PLATE

LXII—(*continued*).

Fig. 5. Outline of another mutilated antenna of the same species, 5 June, × 60

6. The same, 17 June, × 60

7. „ 24 „ „

8. Part of head of *Smynthurus* from below, to show the orifice of the tracheæ.

9. Part of respiratory system of *Smynthurus* × 30

10. Male generative organs, *Papirius ornatus*, × 30

11. Female „ *Smynthurus fuscus*

12. Ventral tube (extended) of *Smynthurus fuscus*, to show the arrangement of the muscles, × 125

LXIII.

Fig. 1. *Smynthurus viridis*. Saltatory appendage × 30

2. — *Bourletii*. „ ×125

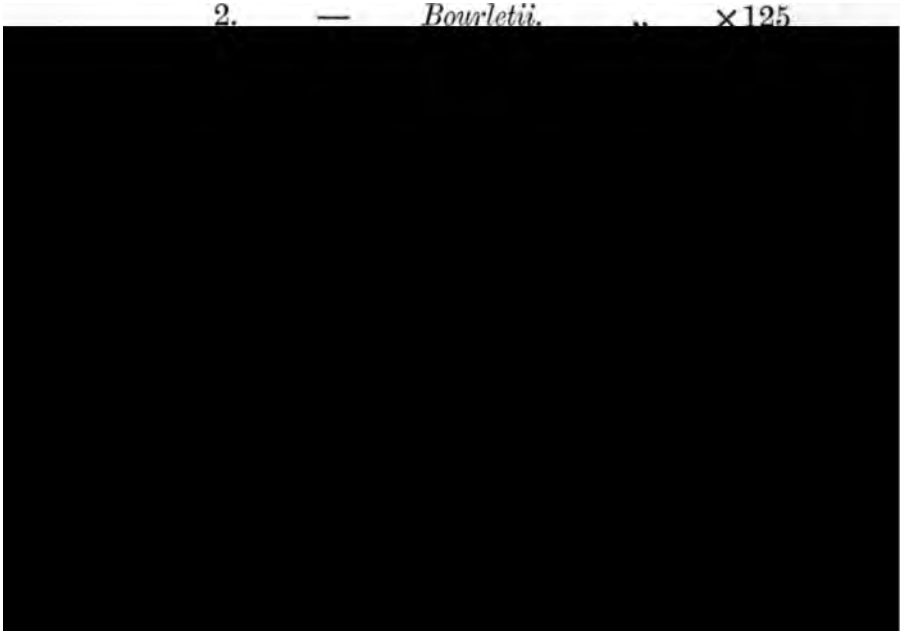


PLATE
LXIV.

Fig. 1. Maxilla of *Tomocerus* × 30
2. Mandible „ × 60
3. Tongue „ „
4. Upper lip „ „
5. Lower lip „ „
6. Palpus „ „
7. Second maxilla „ „
8. Tip of maxilla „ × 250
9. Maxilla of *Smynthurus fuscus* × 60
10. Mandible „ „
11. Palpus „ × 125
12. Labrum „ „
13. Palpus of *Papirius fuscus* „

LXV.

1. Foot of anterior leg of *Papirius fuscus* × 250
2. „ posterior „ „ × 250
3. „ *Smynthurus fuscus* „
4. „ anterior leg of *Papirius ornatus* × 125
5. „ anterior leg of *Tomocerus minor* × 125
6. Hair of *Papirius ornatus* × 250
7. „ *Degeeria lanuginosa* × 250
8. „ „ „
9. „ *Campodea* × 250
10. „ *Lepisma* × 60
11. Foot of *Lipura Burmeisteri* × 250
12. Foot of *Iapyx* × 130. After Meinert, 'Natur. Tidsskrift,' 3 R., 3 B., pl. xxv.

PLATE

LXV—(*continued*).

13. Head of *Iapyx* × 35. After Meinert.
14. Mouth parts of *Campodea* × 65. After Meinert.
15. Post-antennal organ of *Lipura maritima*. After Laboulbene.
16. Post antennal organ of *Lipura Burmeisteri* × 250

LXVI.

Fig. 1. *Machilis maritimus*. Labrum × 30
2. — — Mandible × 15
3. — — Maxilla „
4. — — Labium „
5. — — Ninth abdominal segment of female, seen from below, × 15
6. — — Eighth abdominal segment of female, seen from below, × 15
7. — — Ninth abdominal

PLATE

LXVII.—Scale of *Tomocerus longicornis.*

LXVIII. „ — *plumbeus.*

LXIX. „ *Templetonia crystallina.*

LXX. „ *Seira domestica.*

LXXI. „ — *Buskii.*

LXXII. „ *Beckia argentea.*

LXXIII. „ *Lepidocyrtus curvicollis.*

LXXIV. „ — —

LXXV. „ — *violaceus.*

LXXVI. „ *Lepisma saccharina.*

LXXVII. „ *Machilis polypoda.*

LXXVIII. „ „ *maritima.*

Fig. 1.

Nezara viridula

Pl. 2.

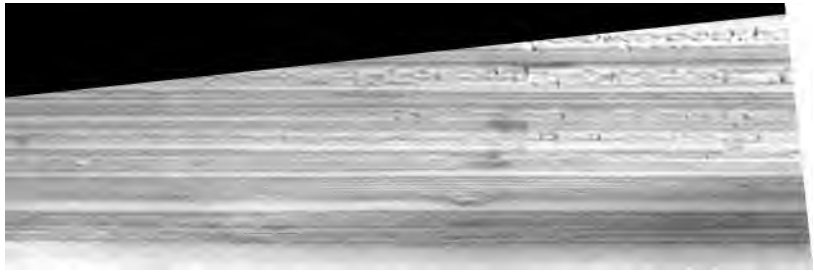
Smynthurus fuscus

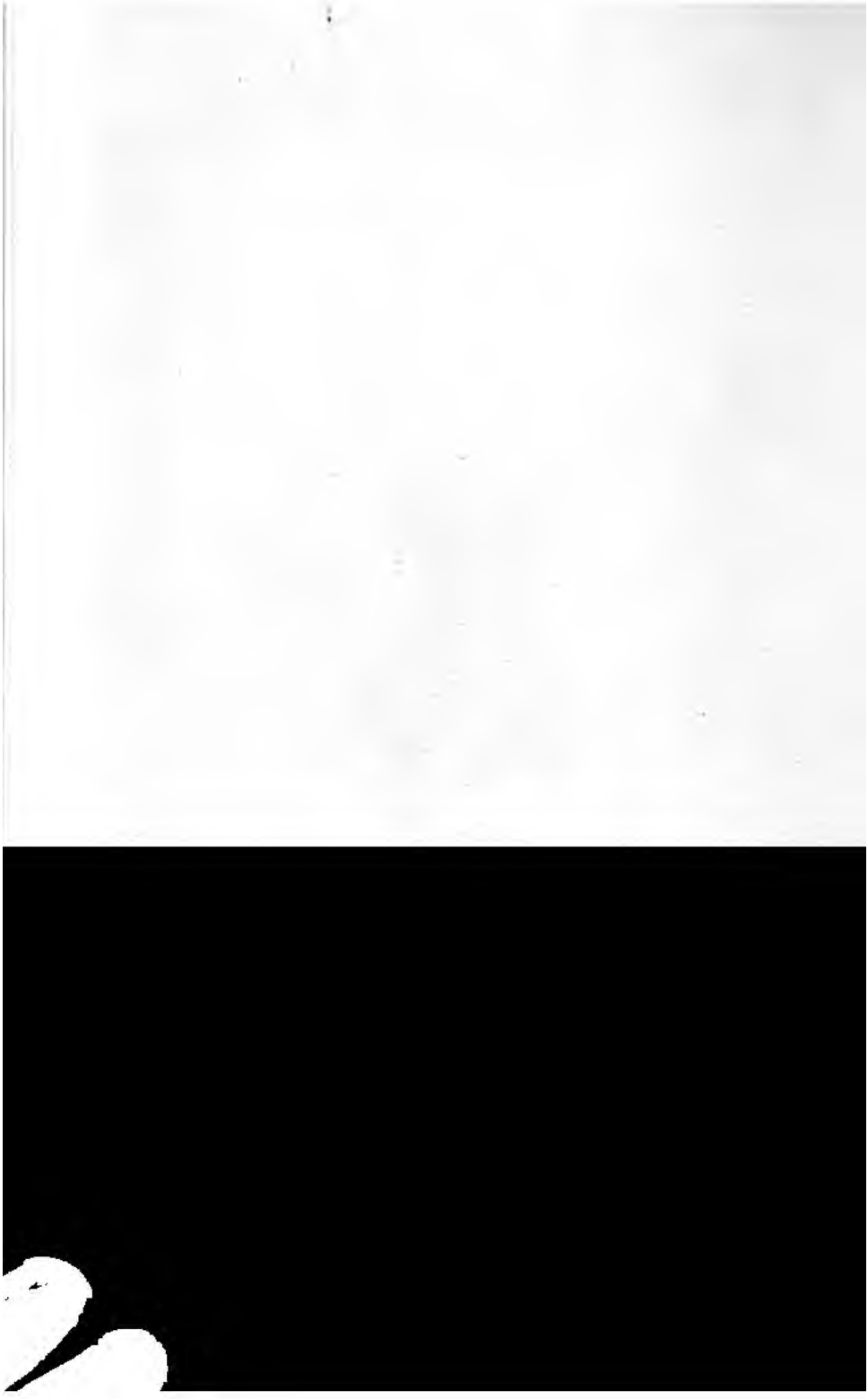
Pl. 4

Smynthurus pallipes.

Pl 5.

Smynthurus Bourletii





Pl 10

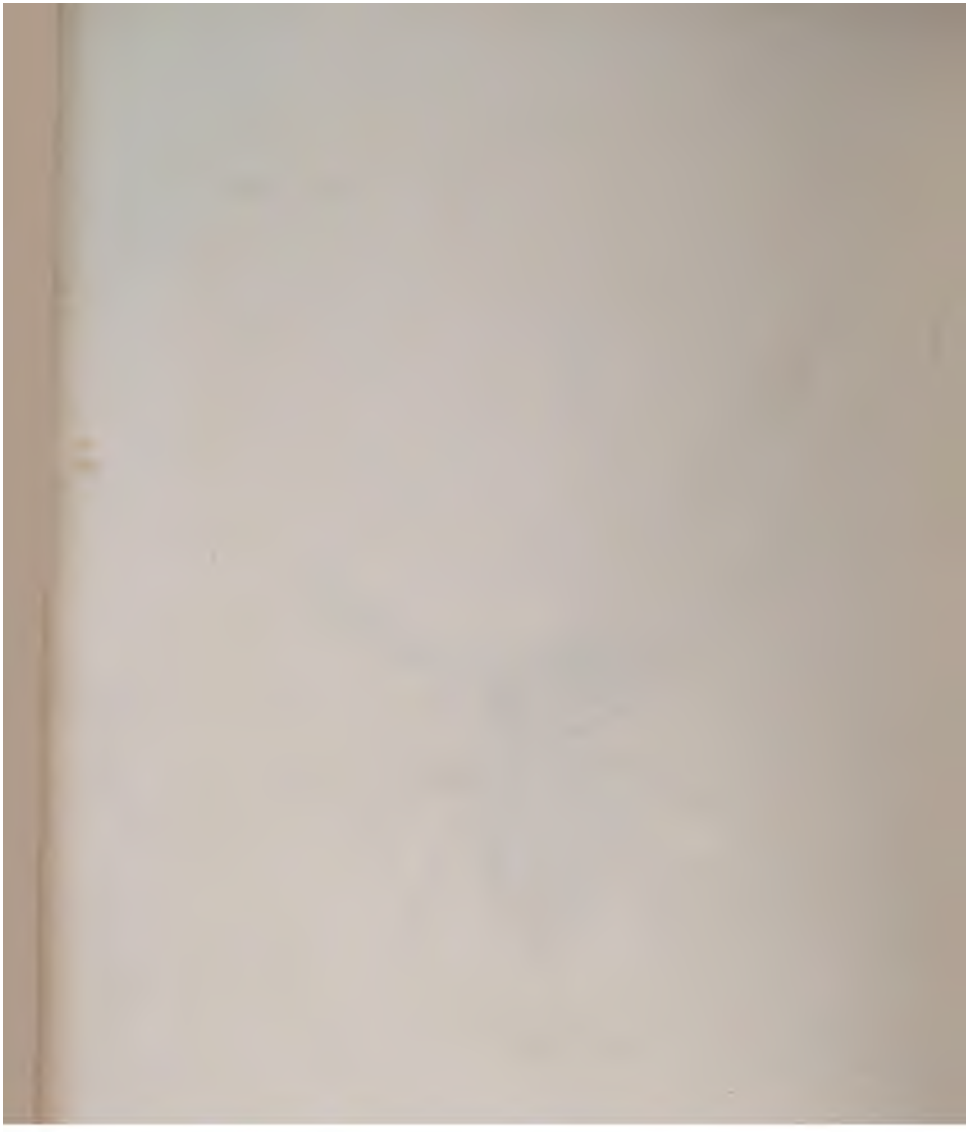
Papurius nigromaculatus

Pl. II.

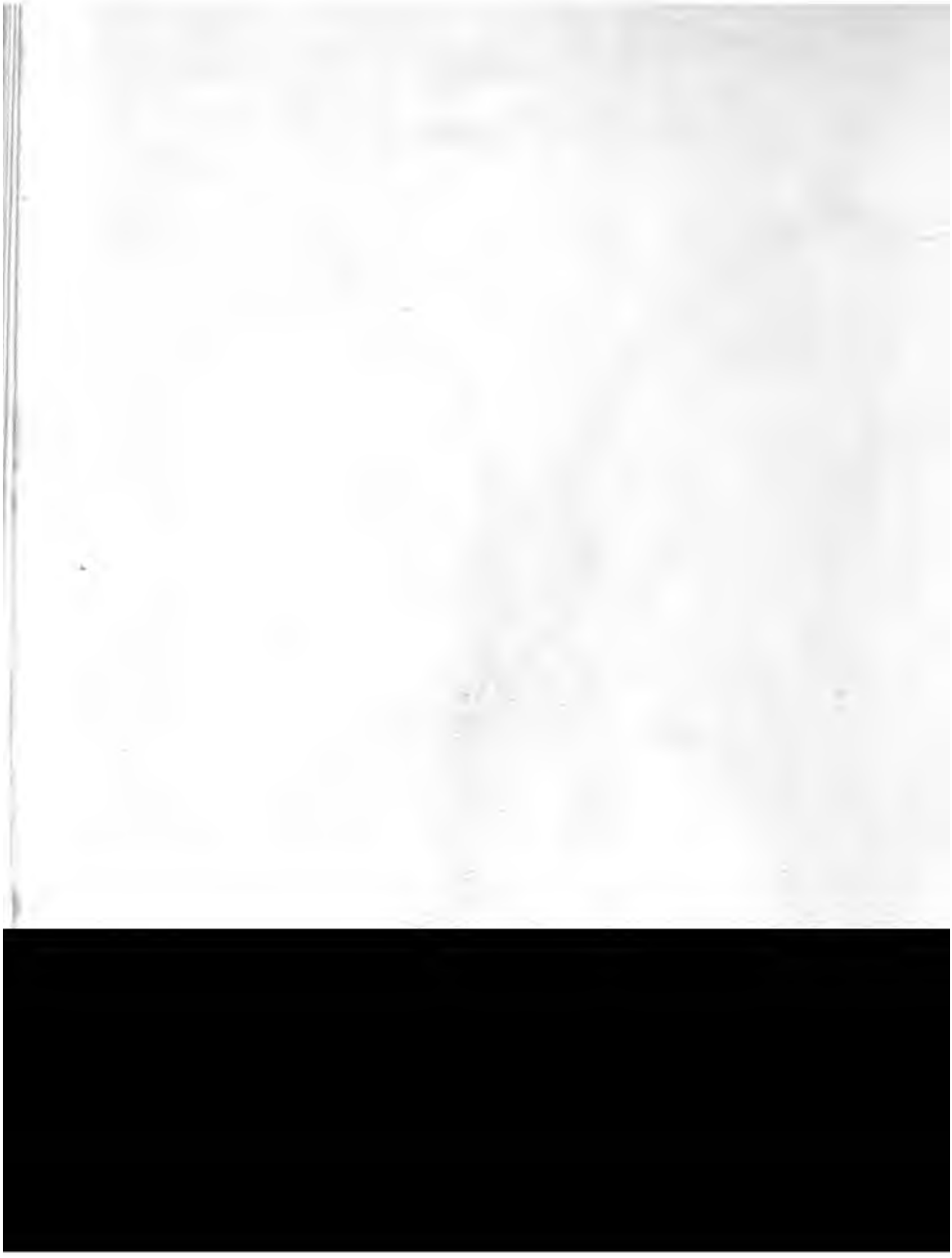
Papirius polypodus ♀.

A.T. McHaffie del. et lith.

W. Black & Co. Imp.

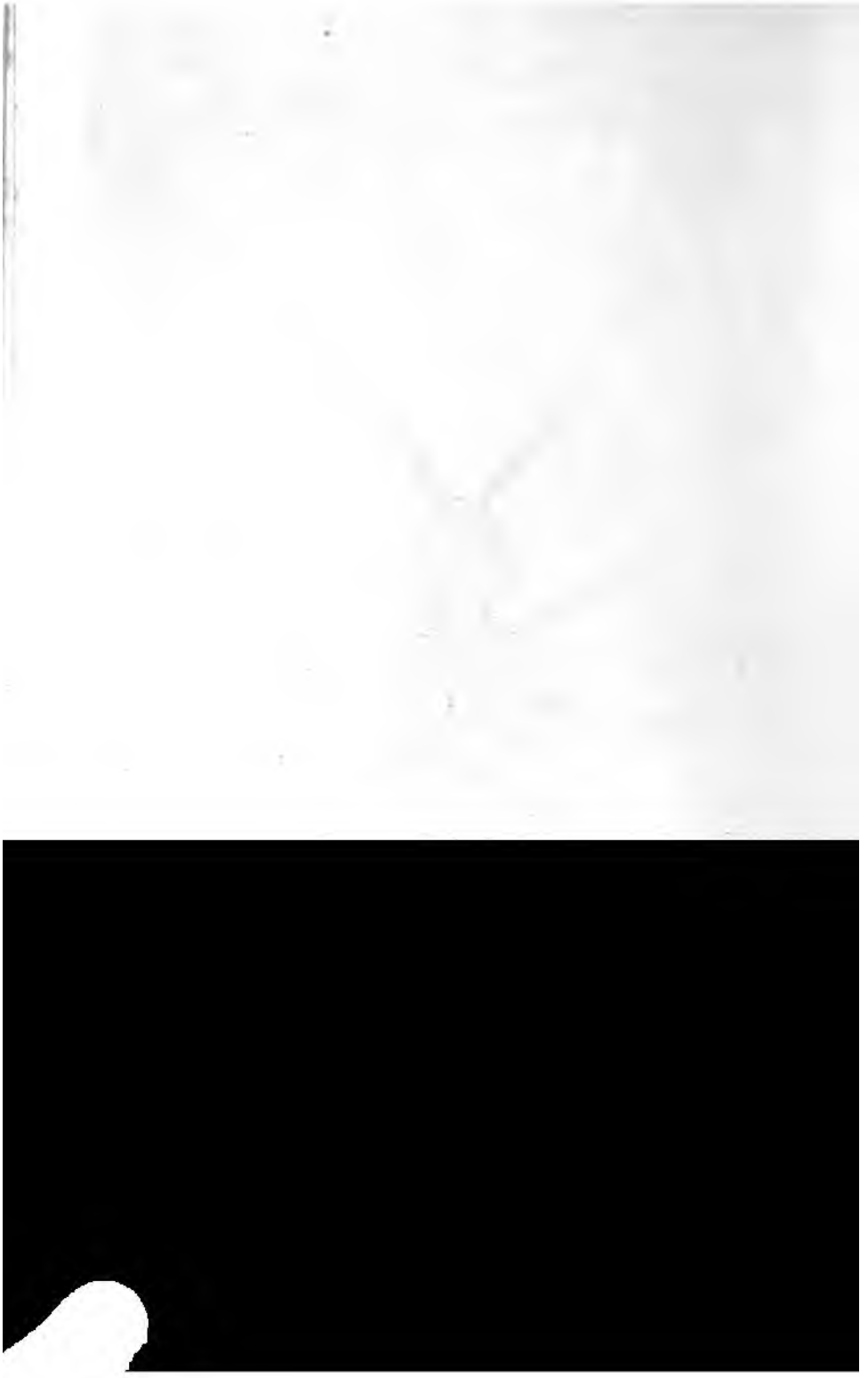


Achorutes Cinctus

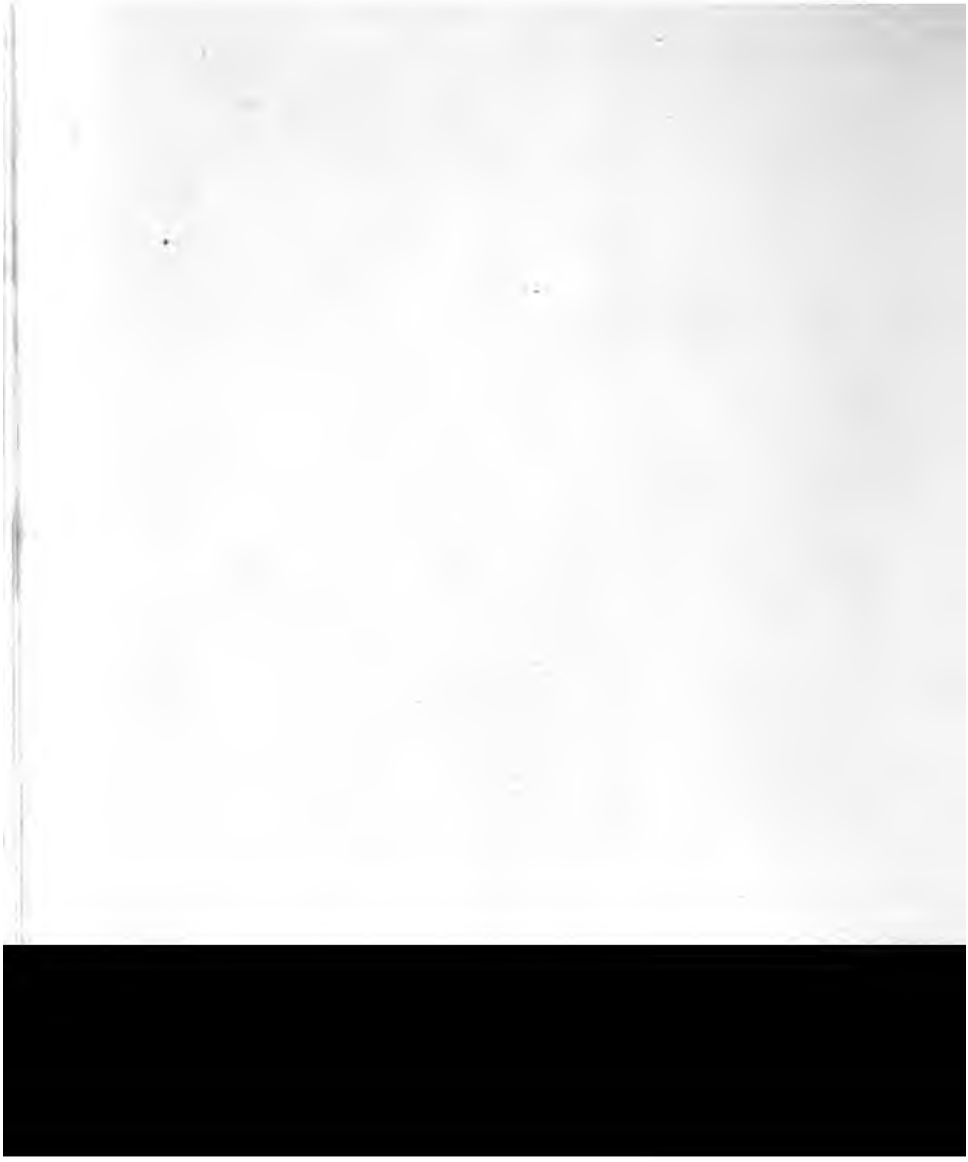


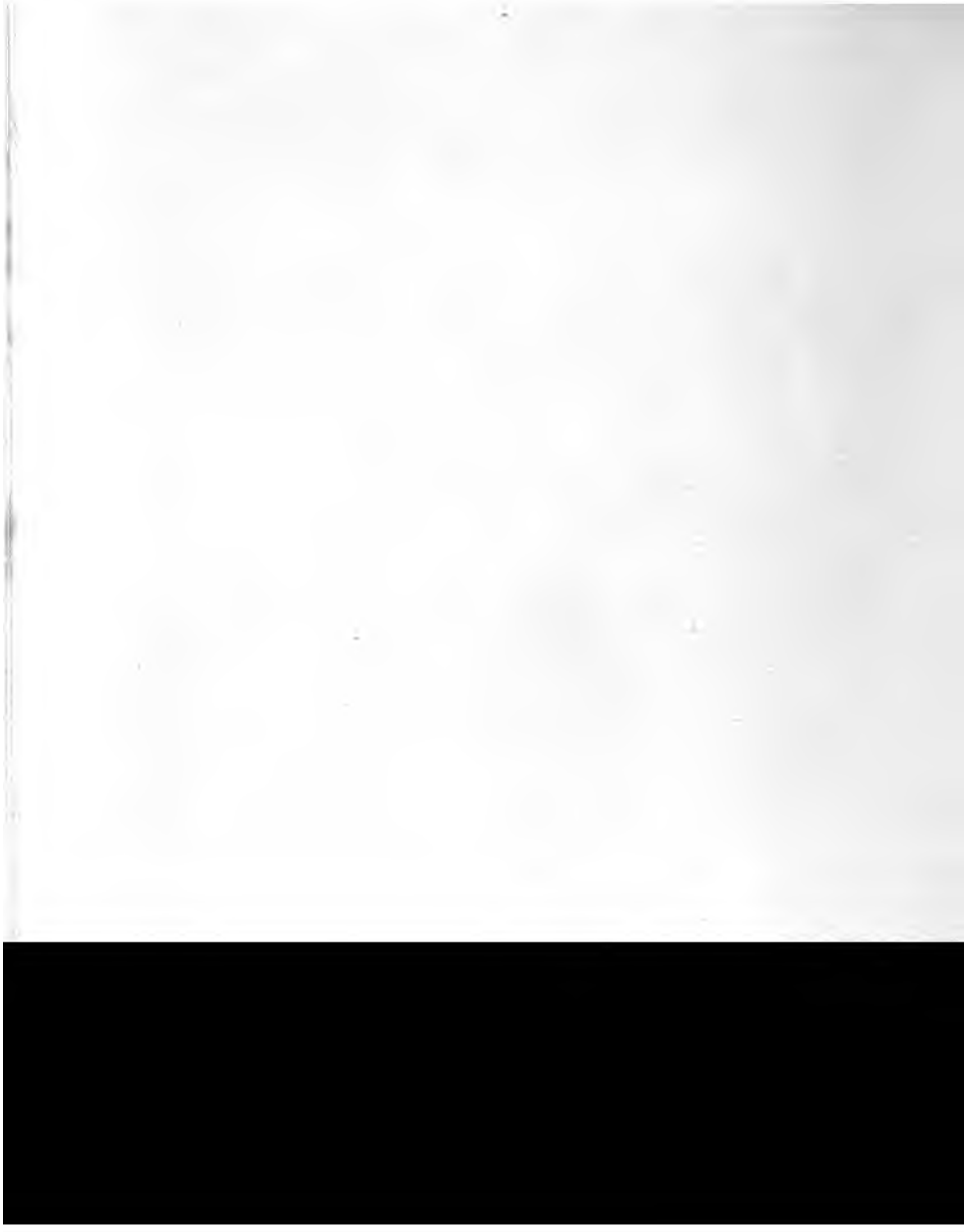
Pl. 14

Orchesella cincta

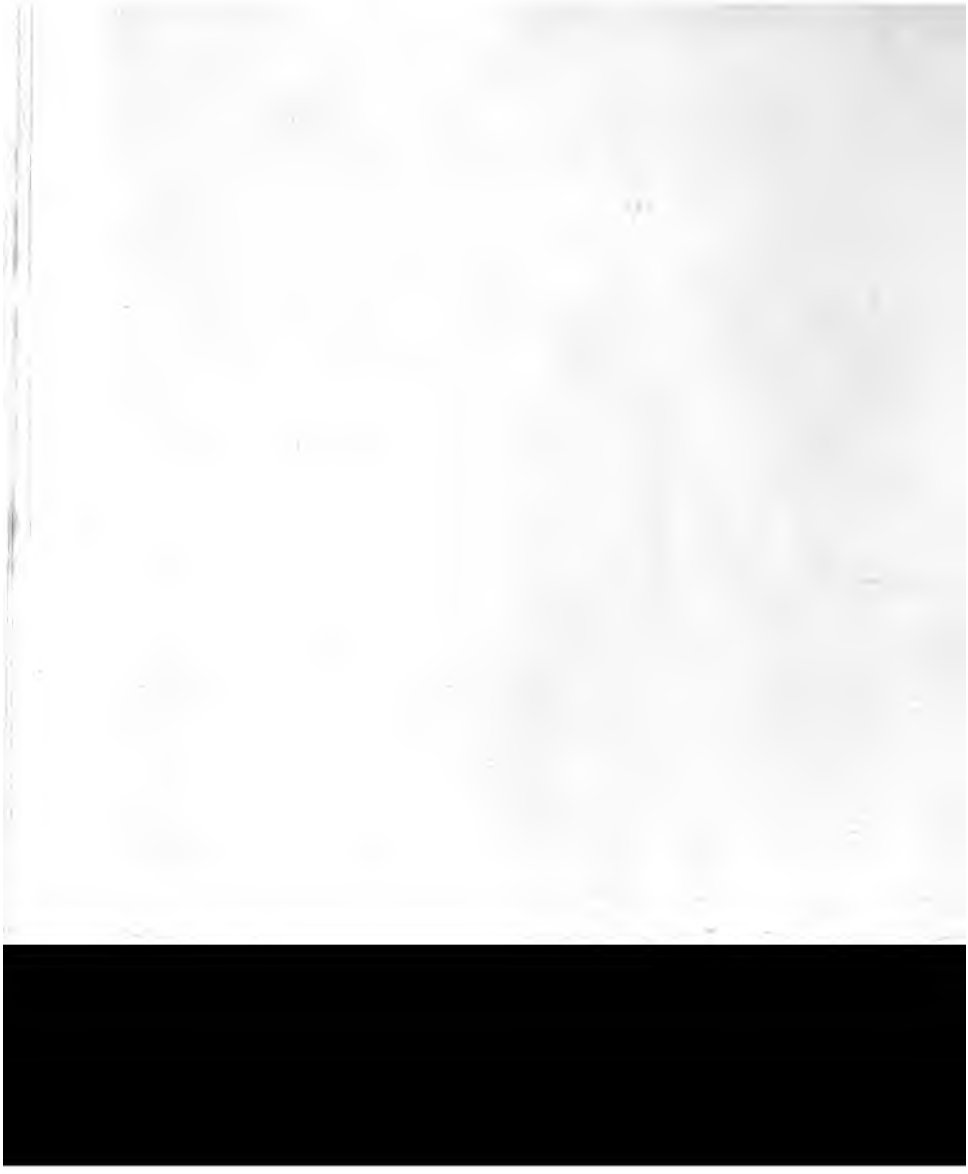


Temnocerus longicornis



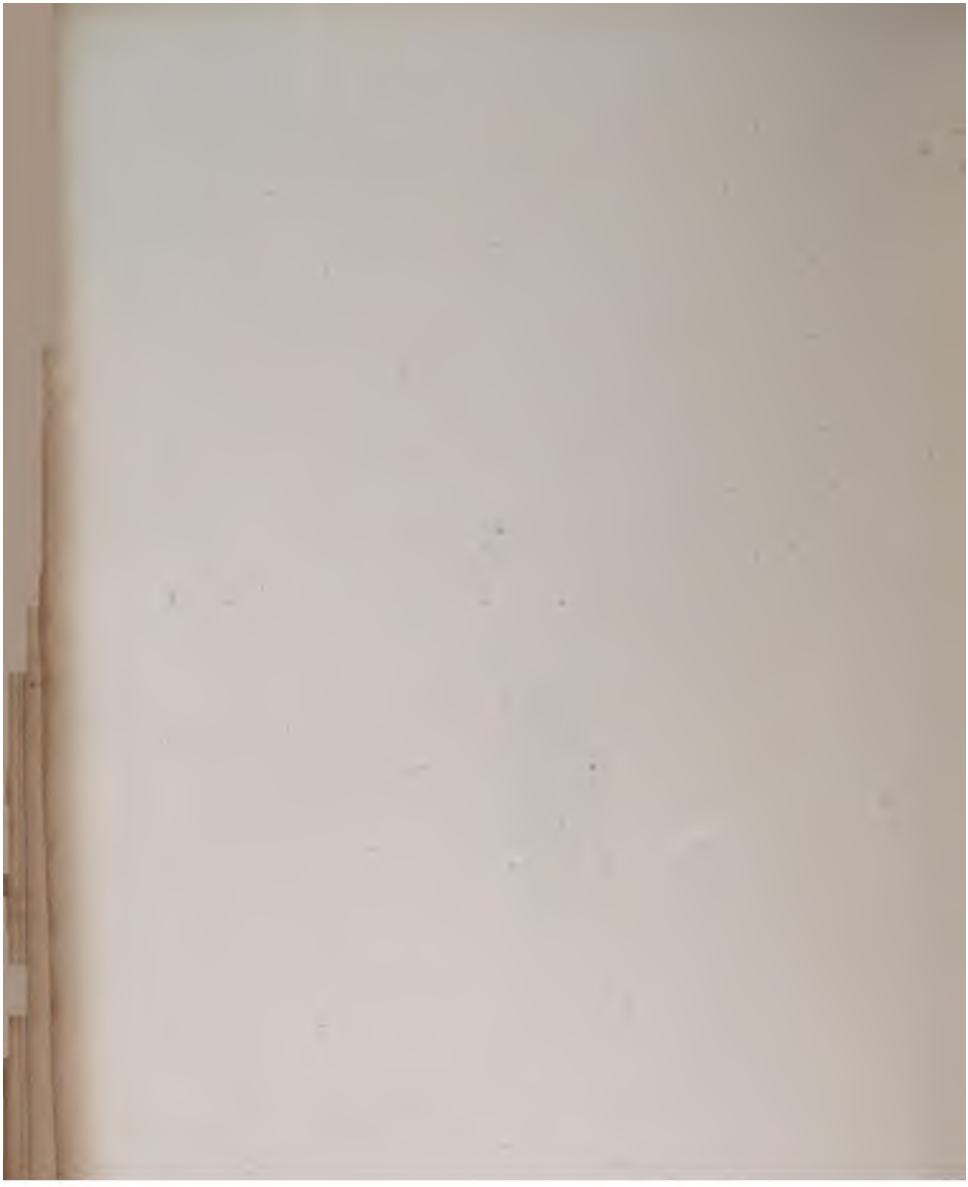


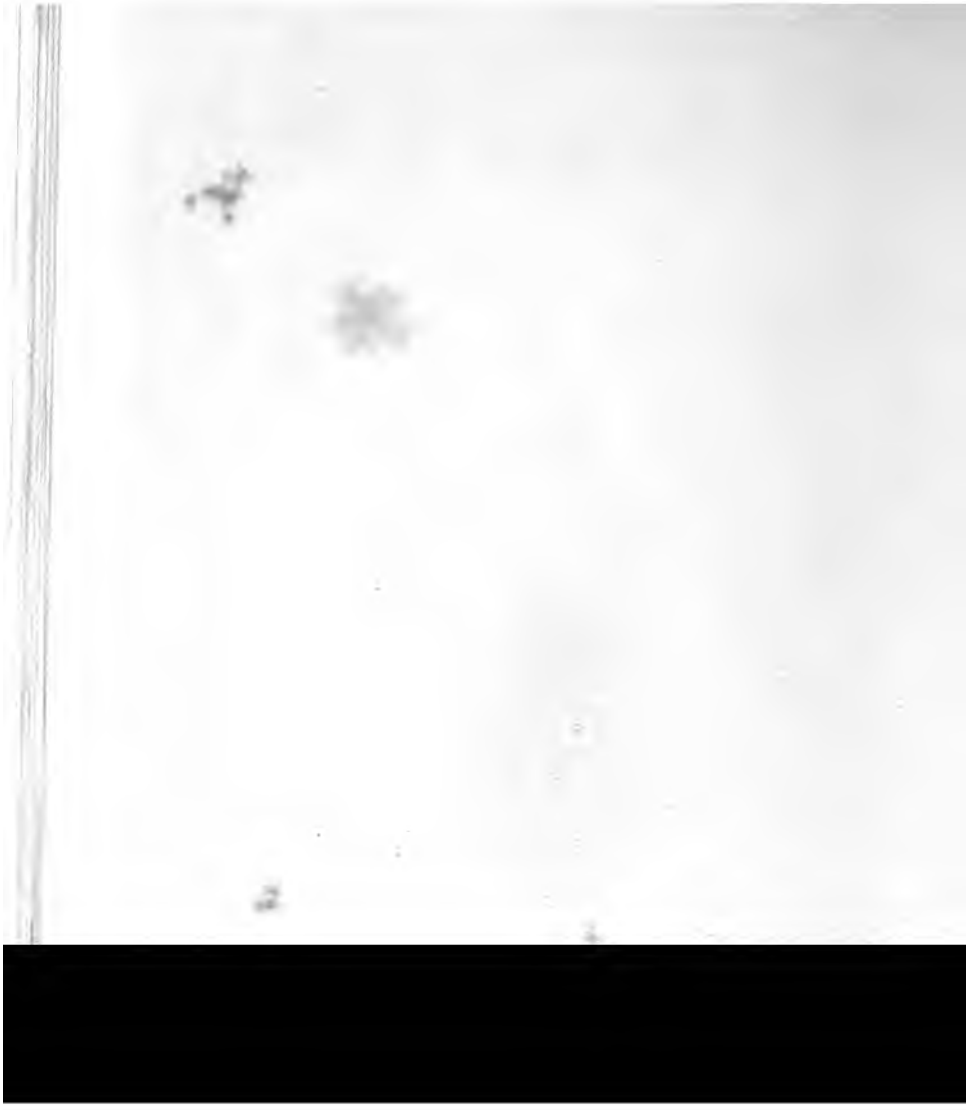
Lepidocyrtus curvicollis



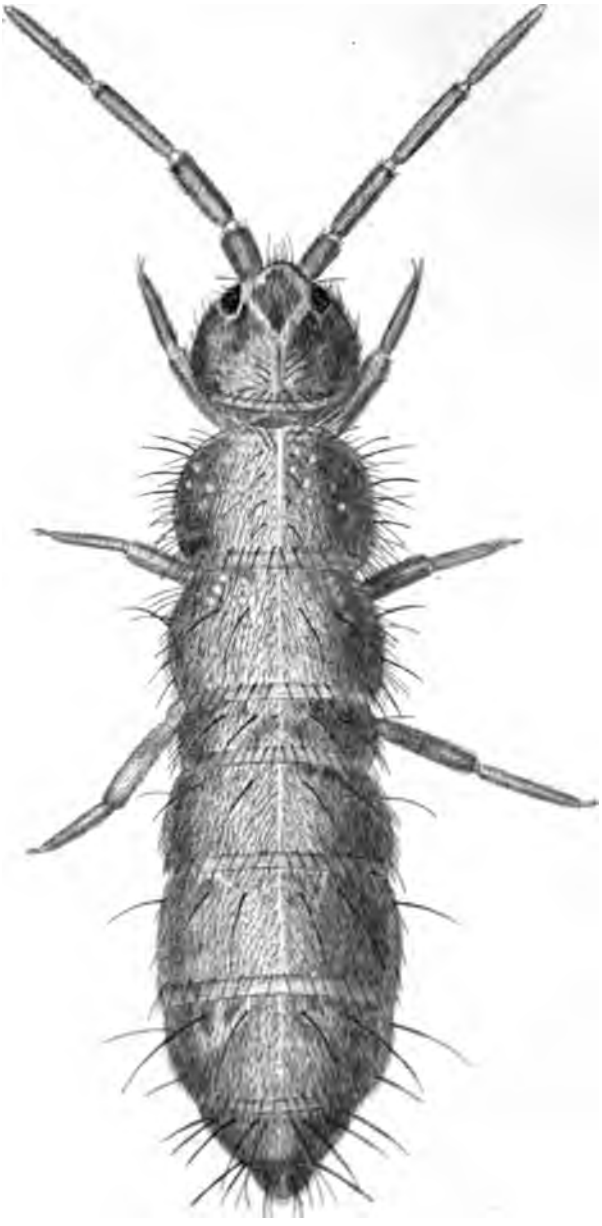
Pl. 87

Lepidocyrtus fibulatus.





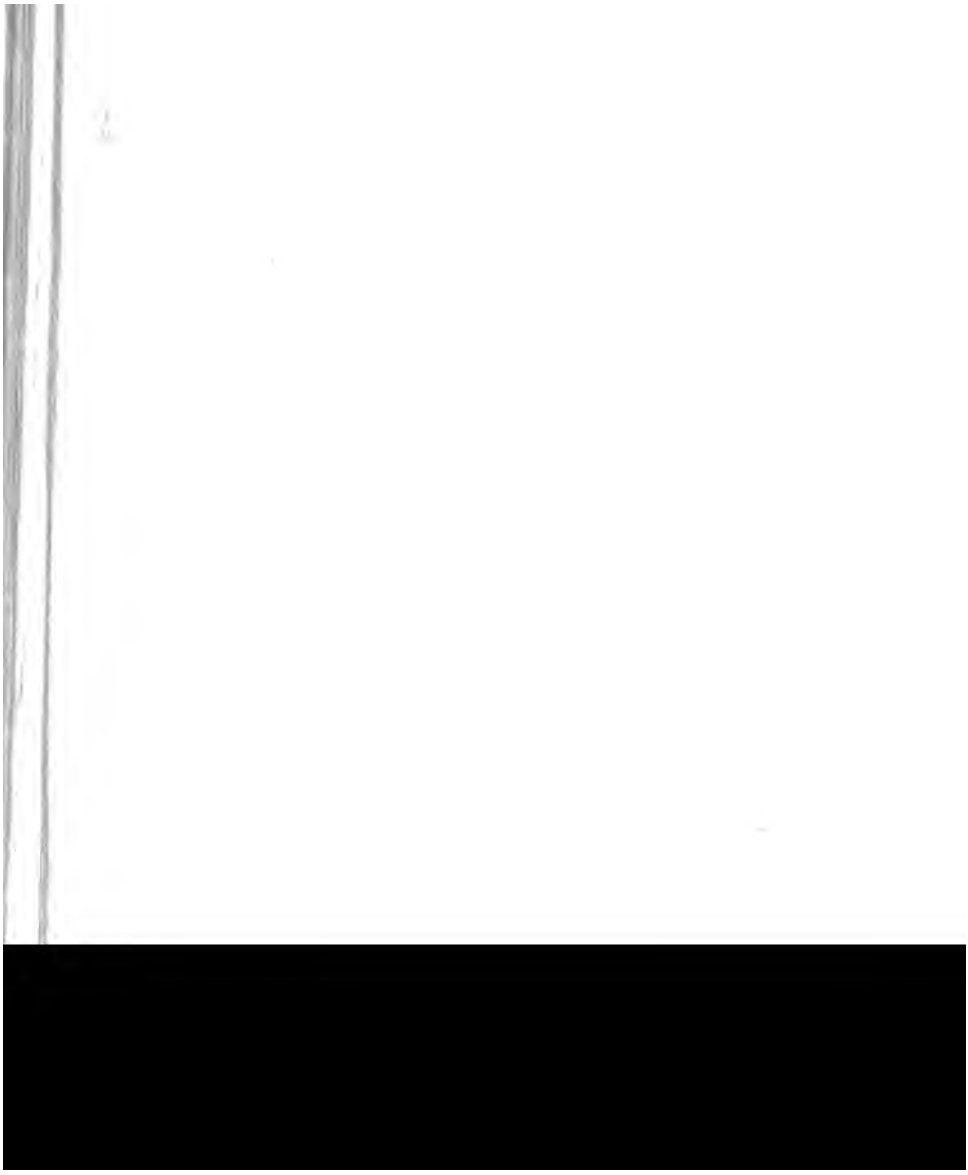
Pl. 36.

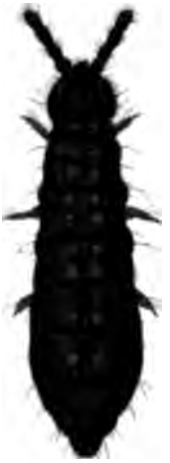


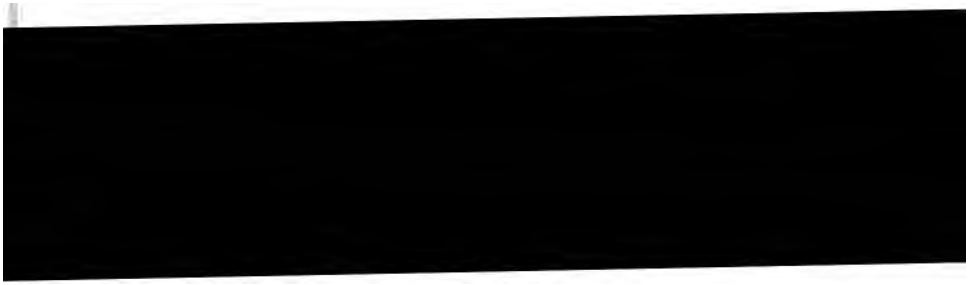
1

2

Achorutes armatus







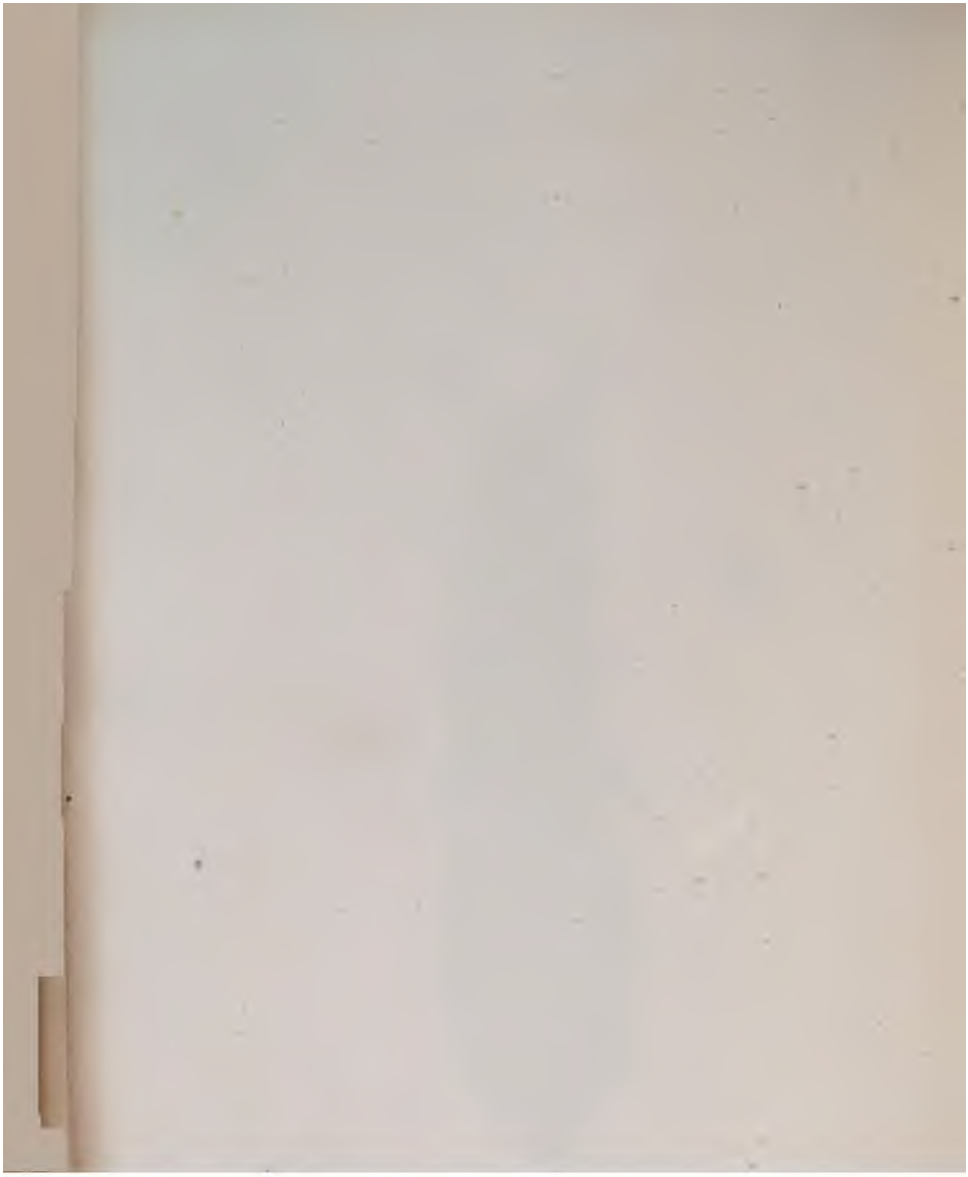
1

2.

[illegible]

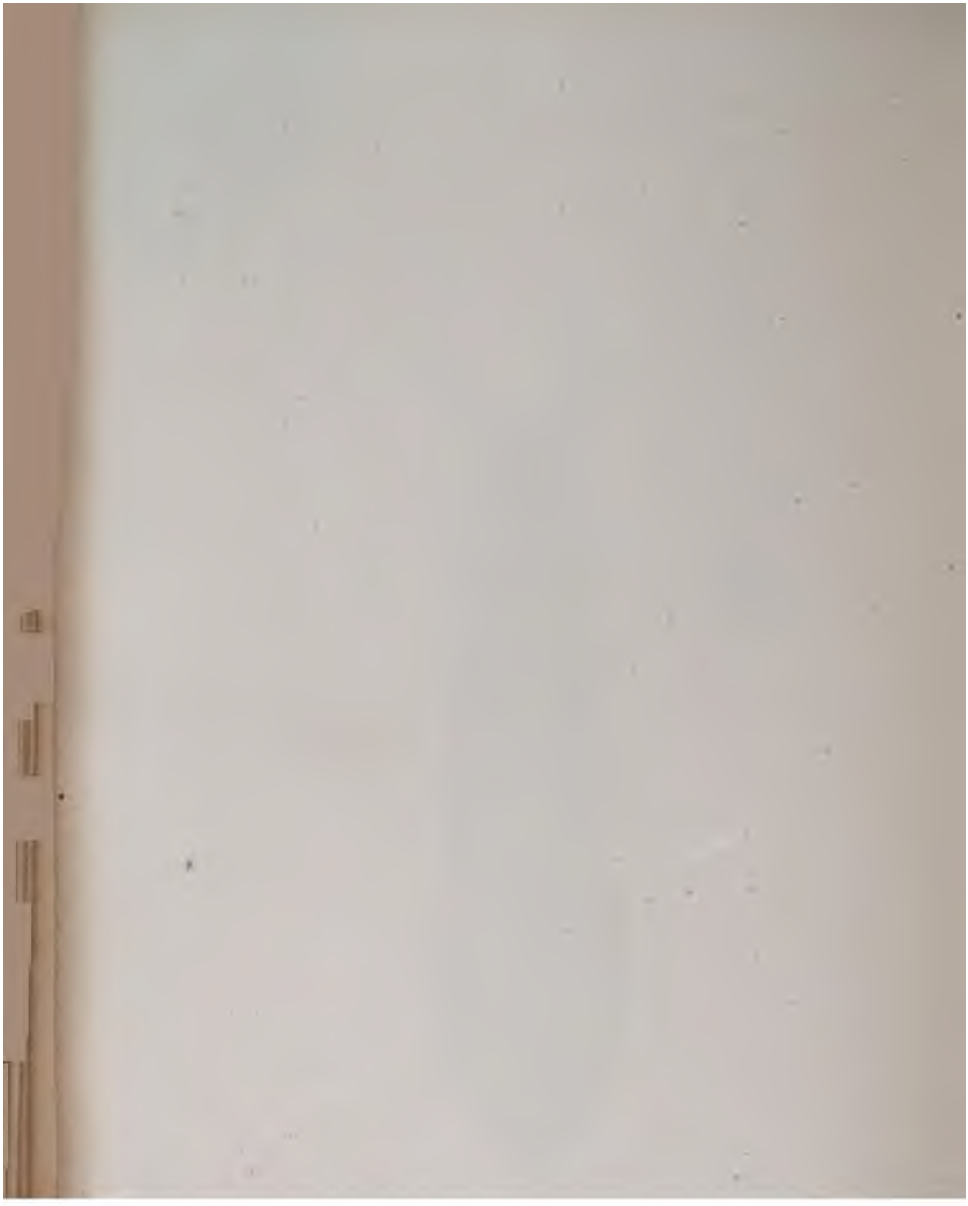
Pl. 47.

Lipura maritima



Pl. 46.

Lipura fimetaria



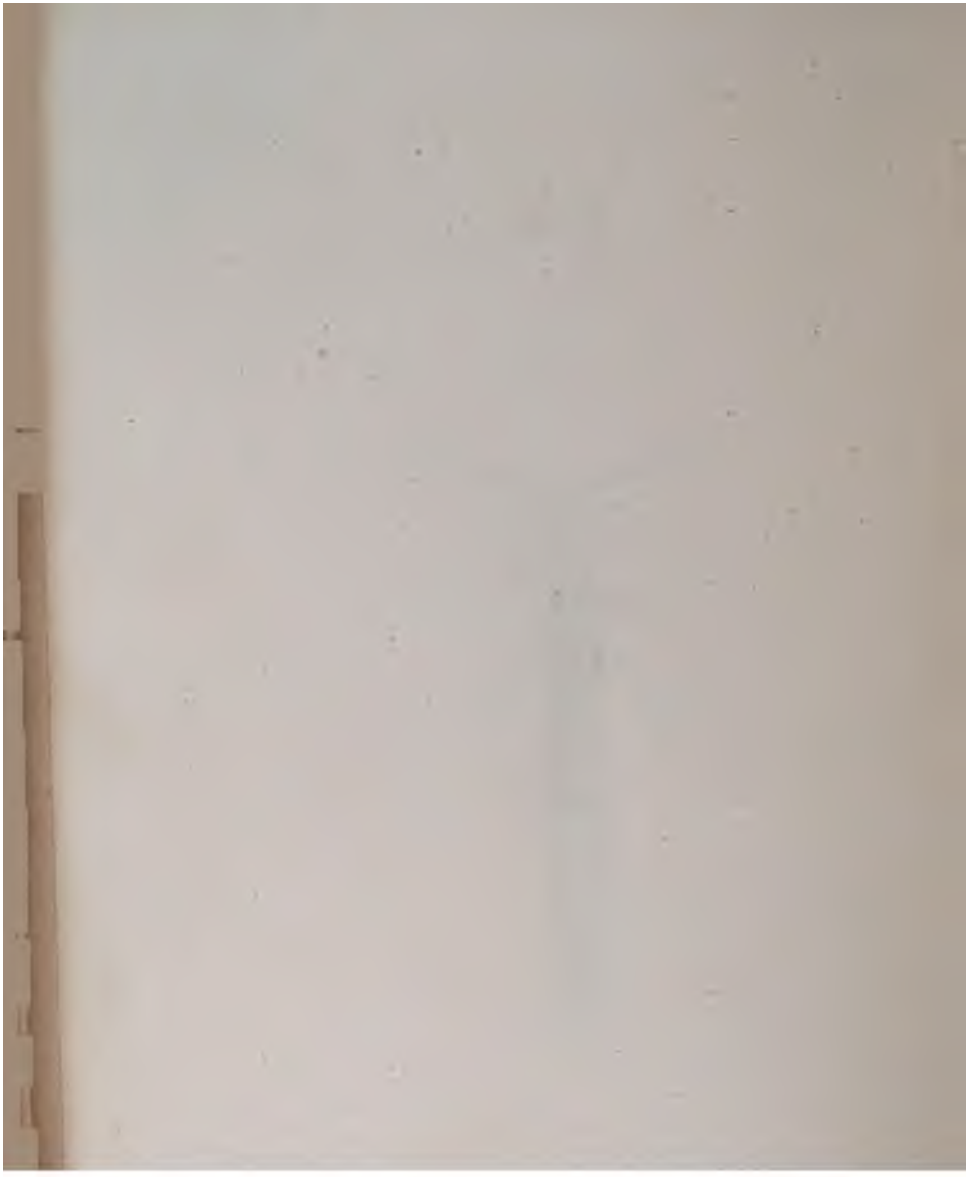
Anoura [illegible]

Lithog. del. et lith.

W. West & Co. imp.

Pl. 51.

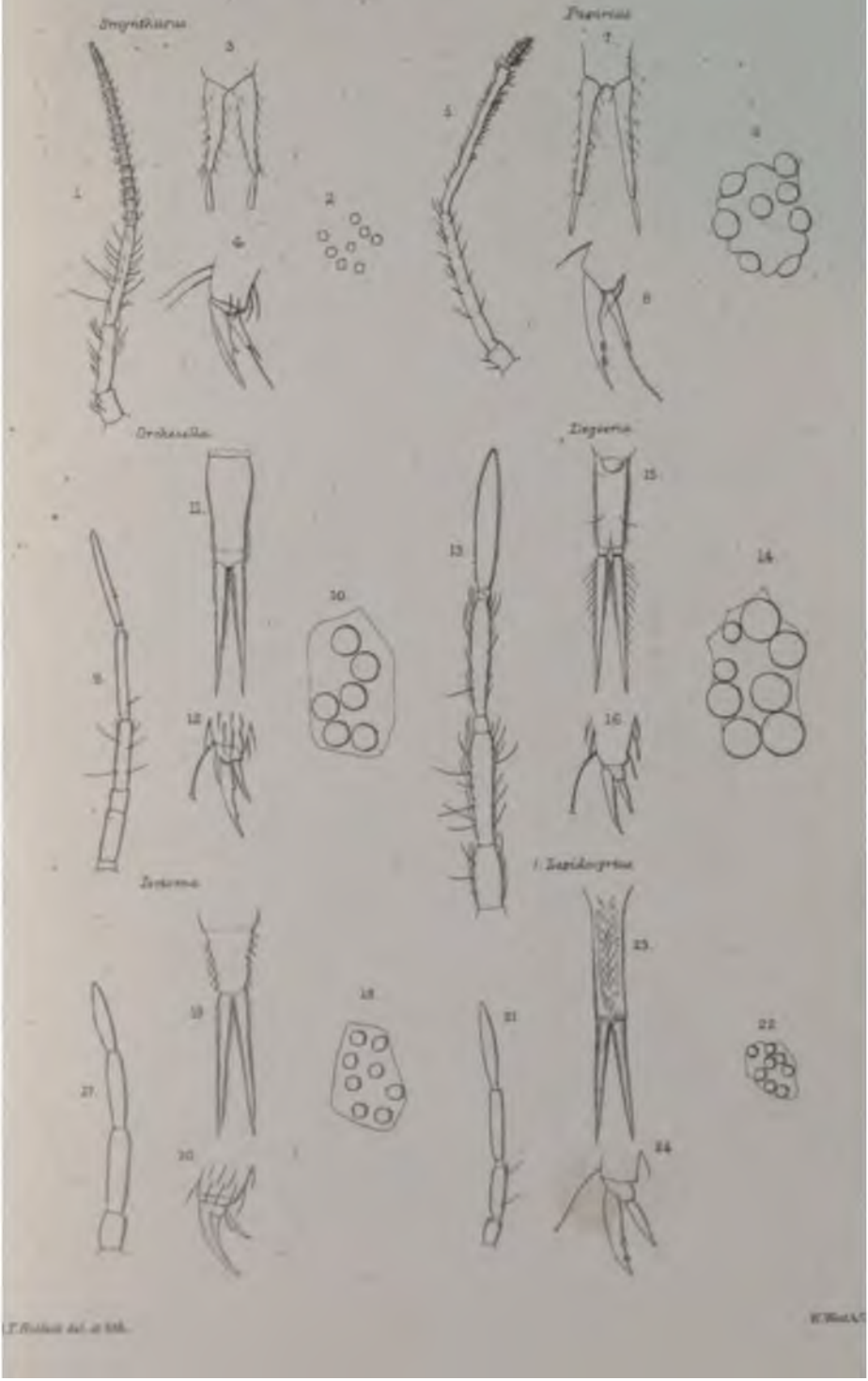
Japyx Solifugus

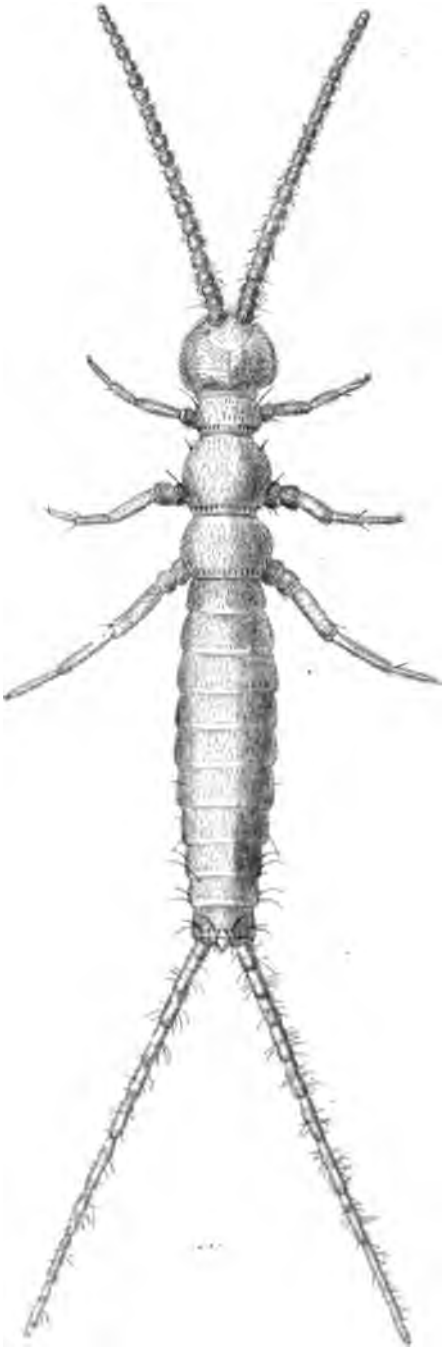


Lepisma Saccharina.

Machilis polypoda

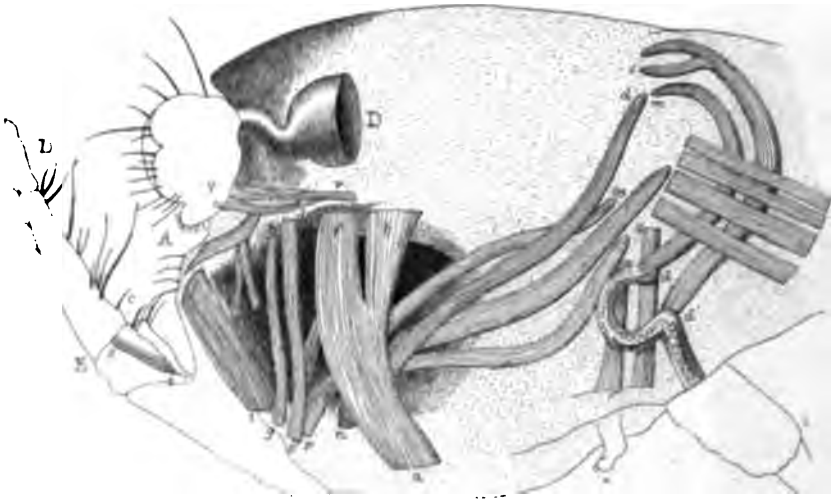
PL. 55.


Smynthurus
Pseudosinella
Orchesella
Degeeria
Isotoma
Lepidocyrtus

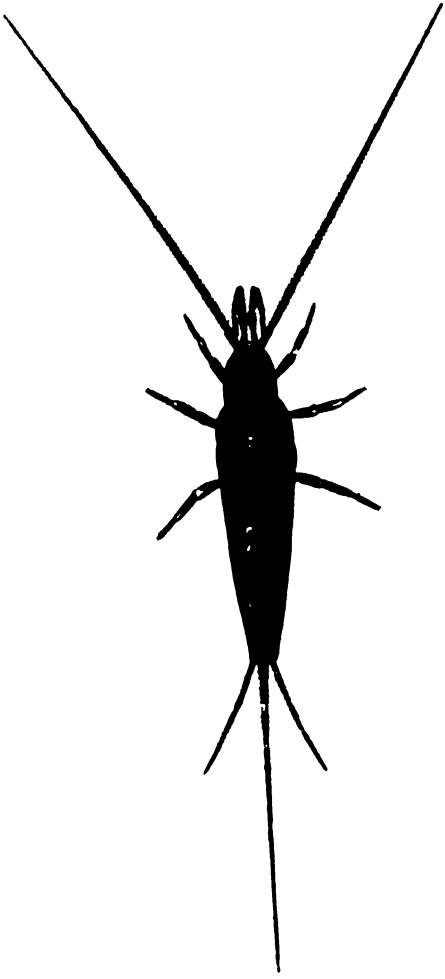


Campodea staphylinus

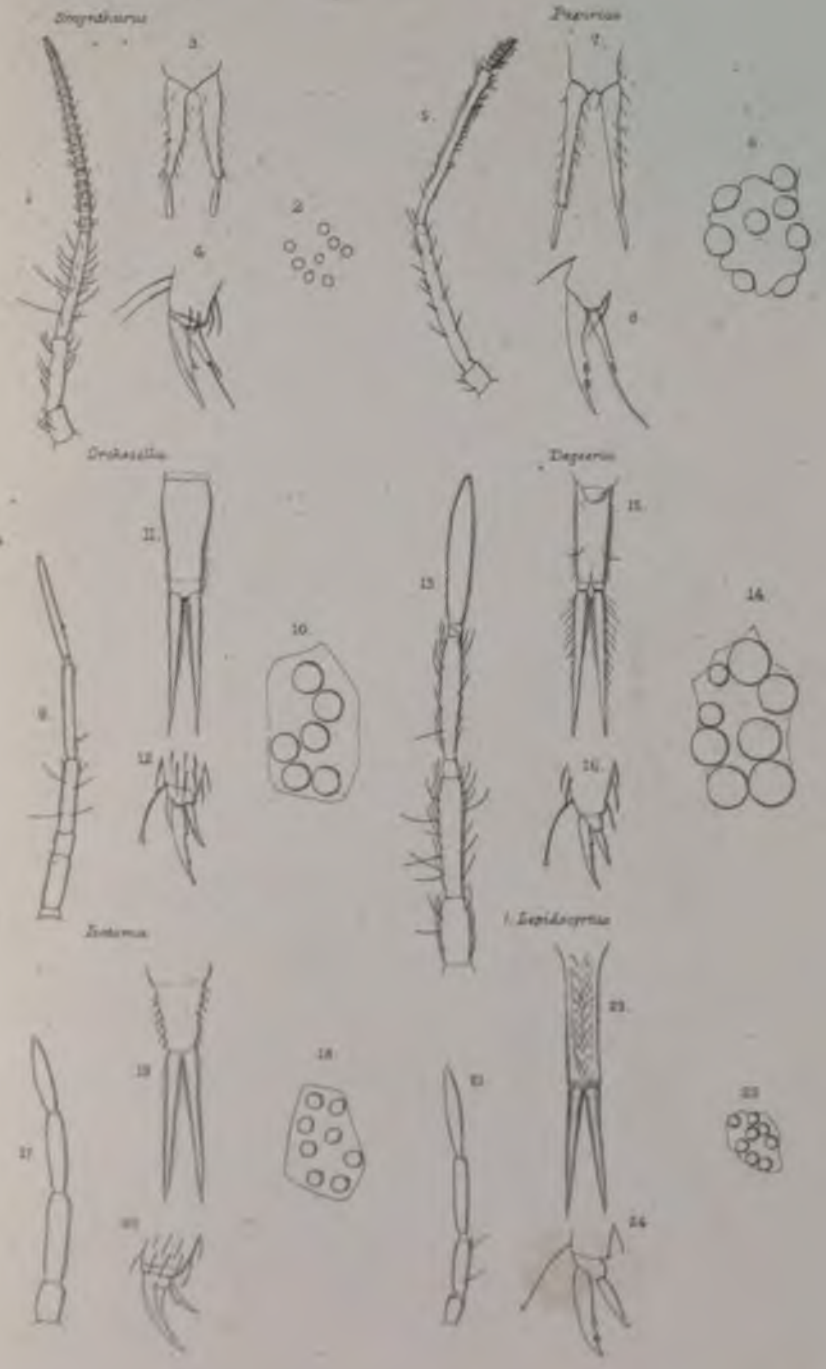
Pl. 57.



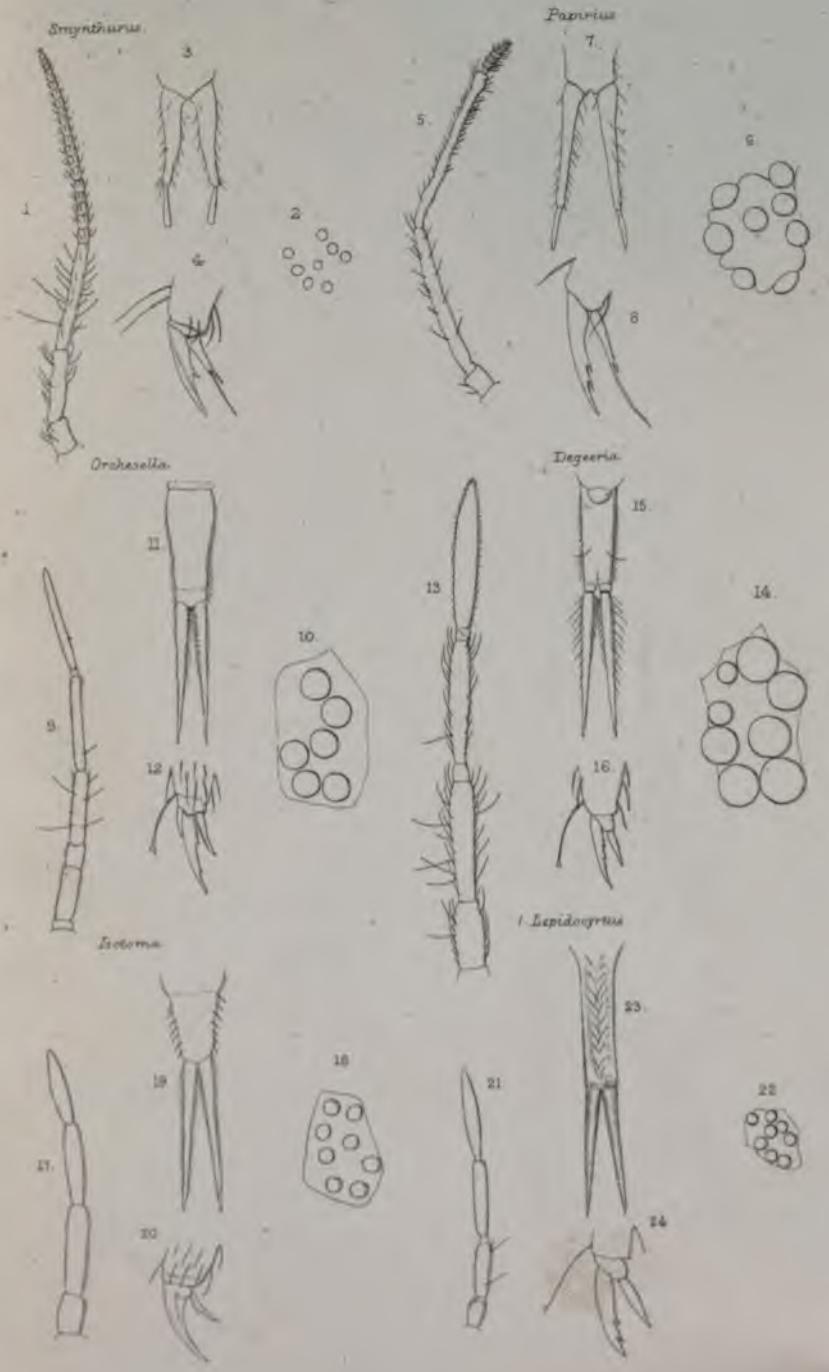
Machilis polypoda



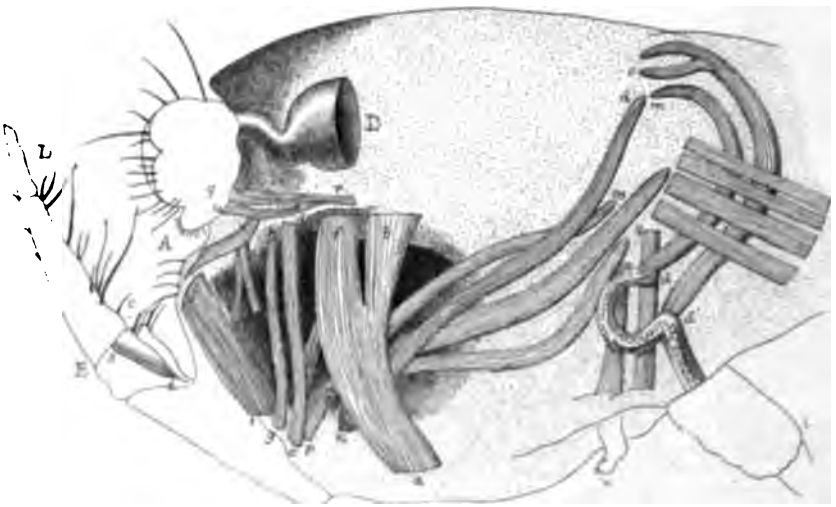
Pl. 55.


Stagonolepis
Diplurus
Orthocolla
Dagnerus
Isodactylus
Lepidocyrtus

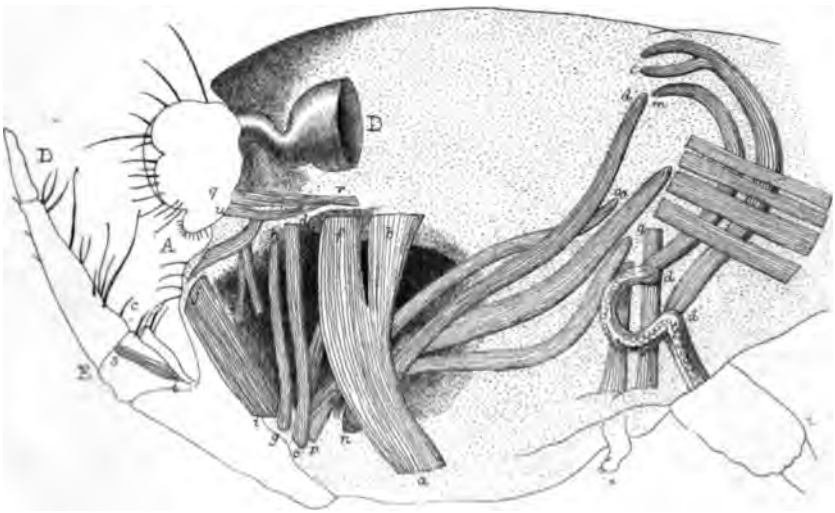
Pl. 55.

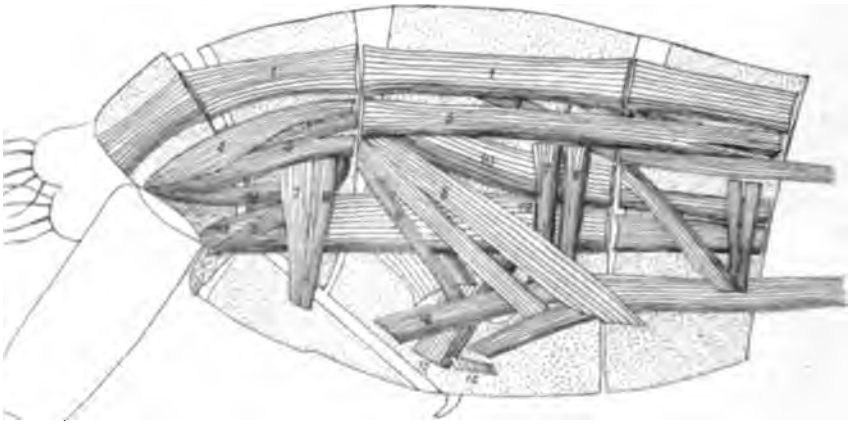

Smynthurus.
Papirius.
Orchesella.
Degeeria.
Isotoma.
Lepidocyrtus.

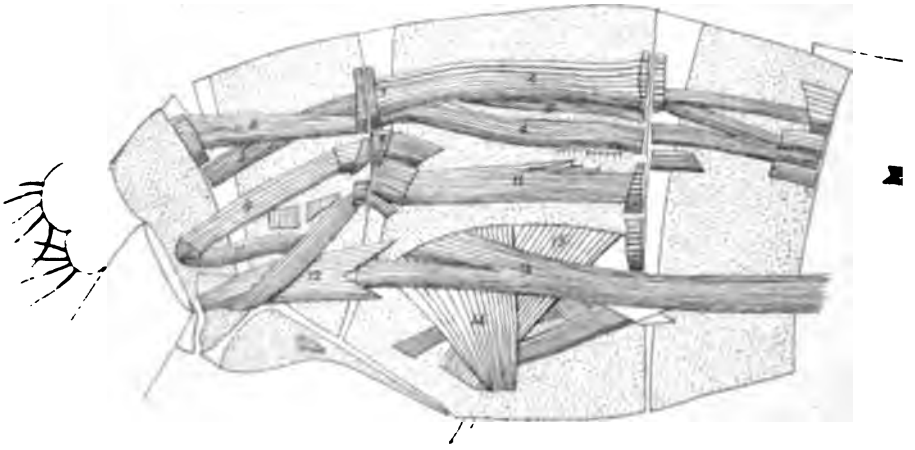
Pl. 57.



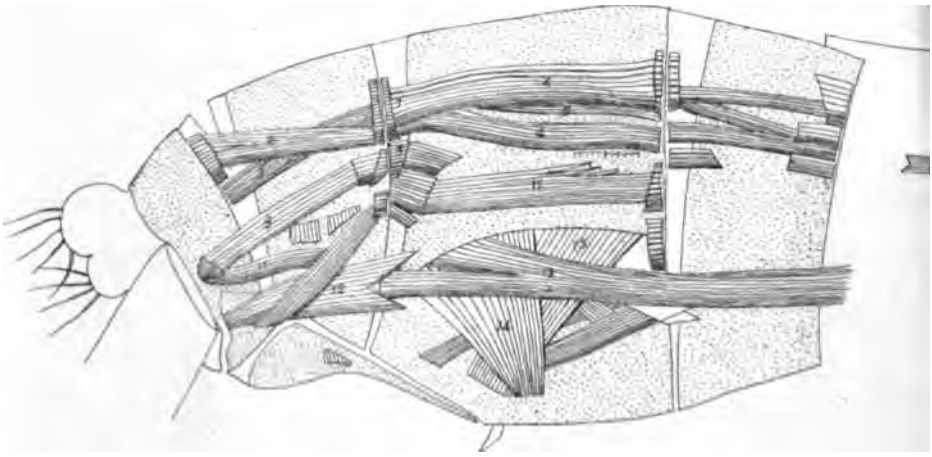
Pl. 57.

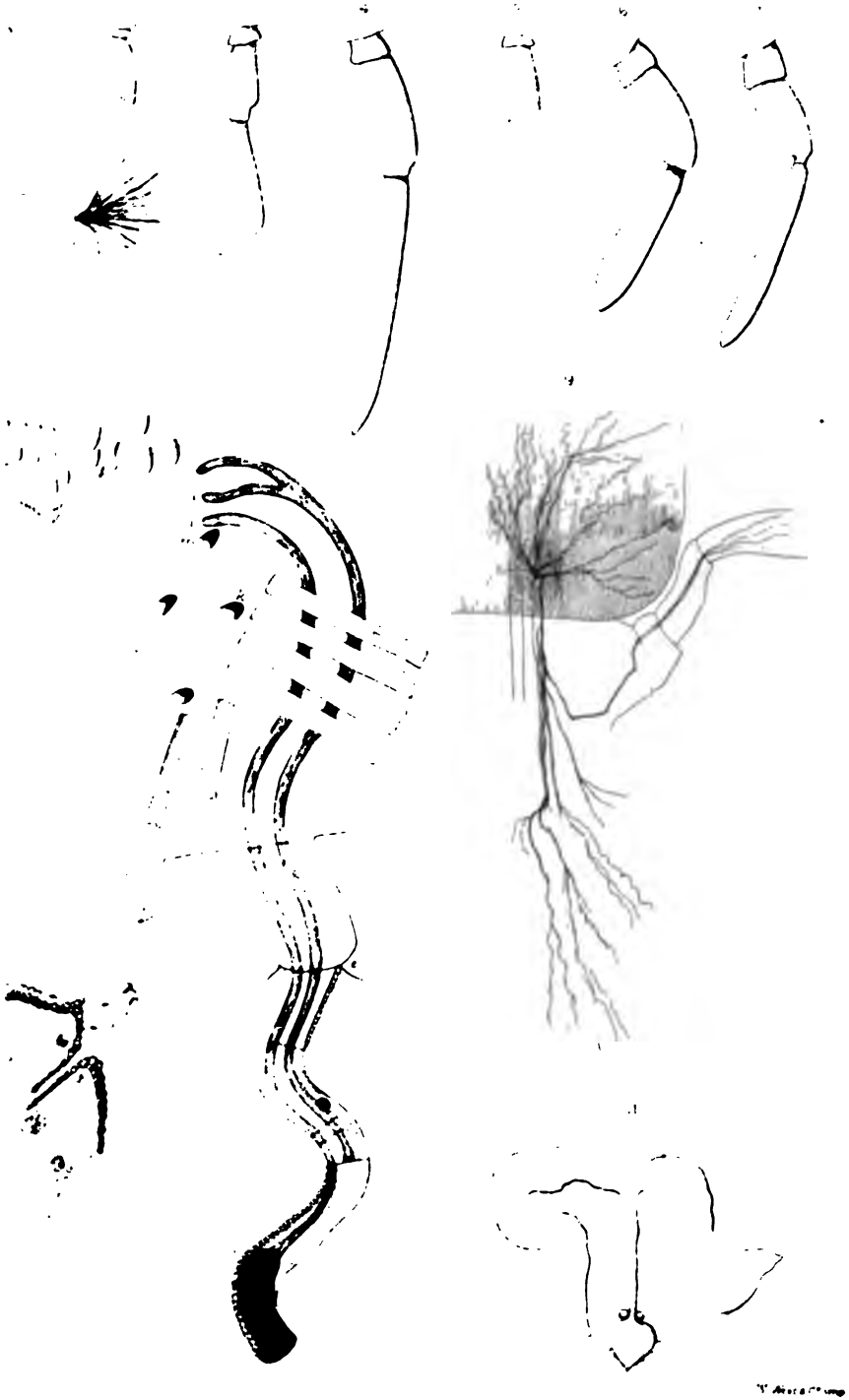


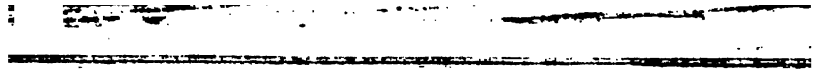


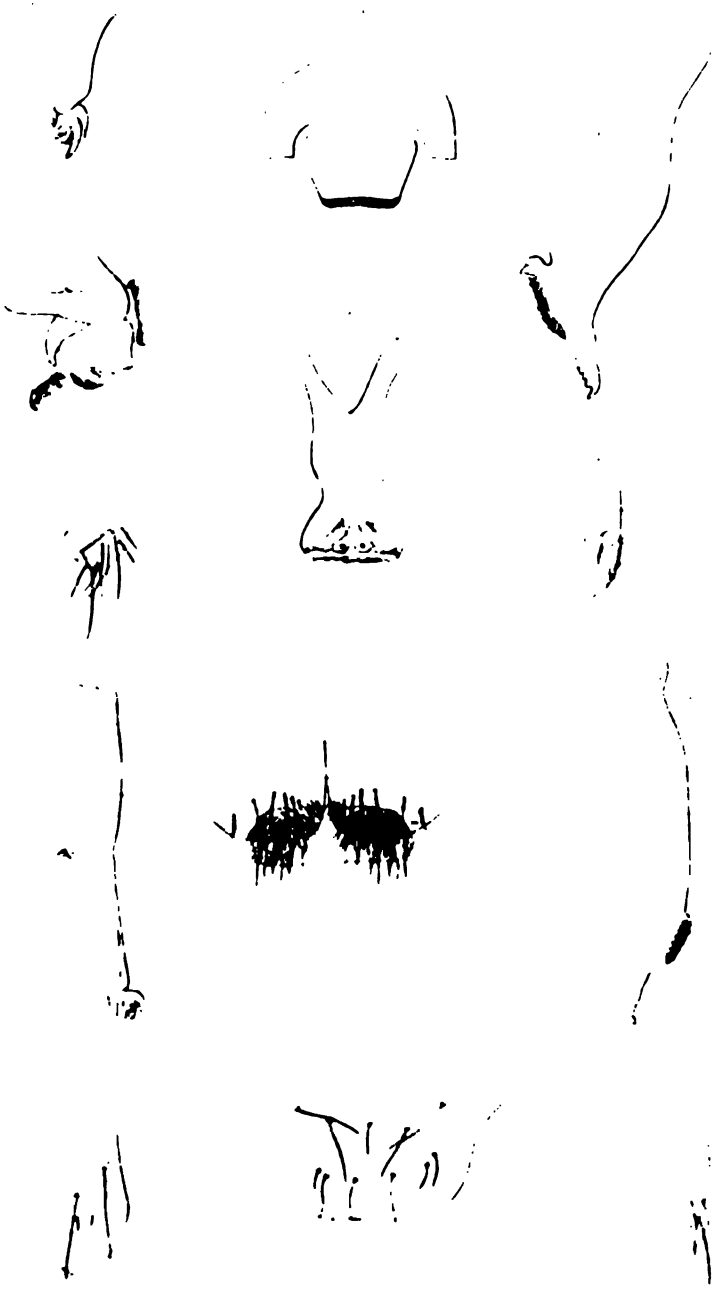


Pl. 60.

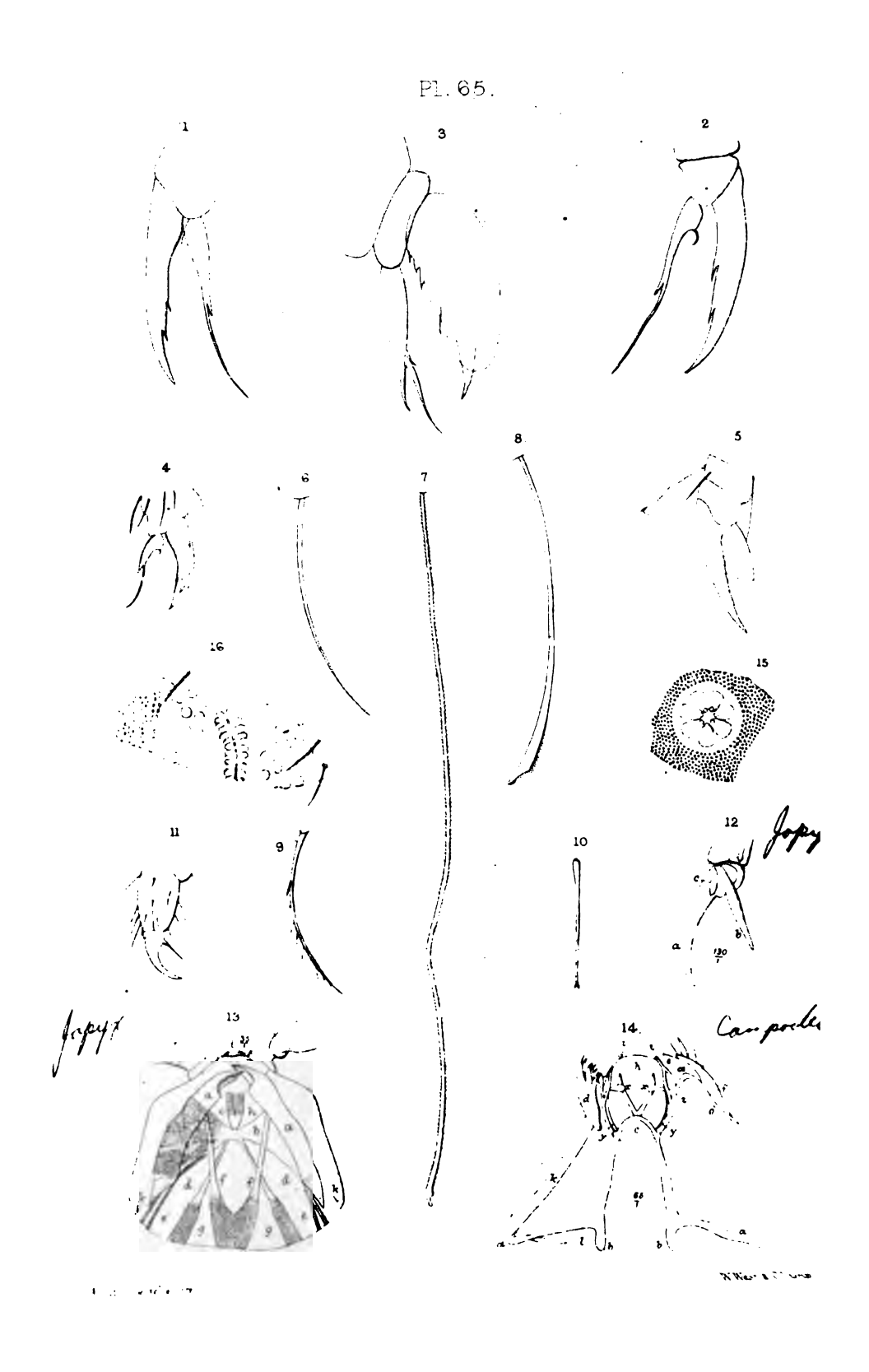








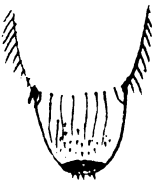
Pl. 65.



Pl. 66.

1-7 Machilis maritimus

FIG. 1



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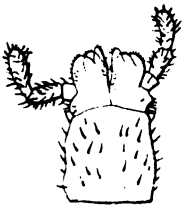
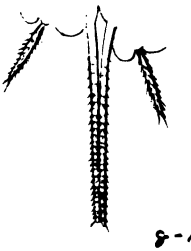


2

5 ♀ 7th abd. sg.

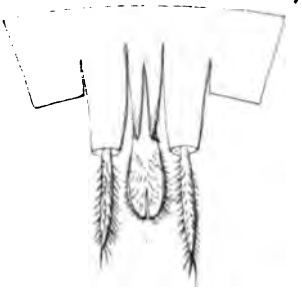
3

6 ♂ 7th abd. s



♂-11 Lepi
saccharin

7 ♀ 7th abd. sg.



8

9

12

11

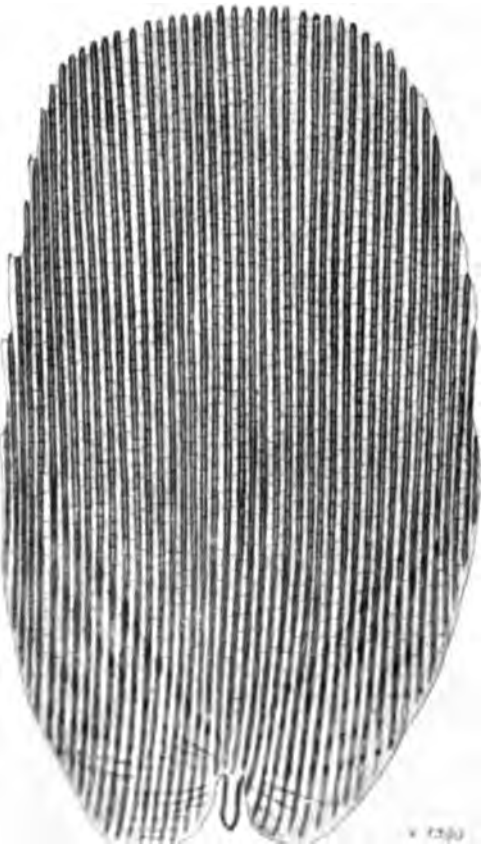
10

12-15 ... stop ...

13

14

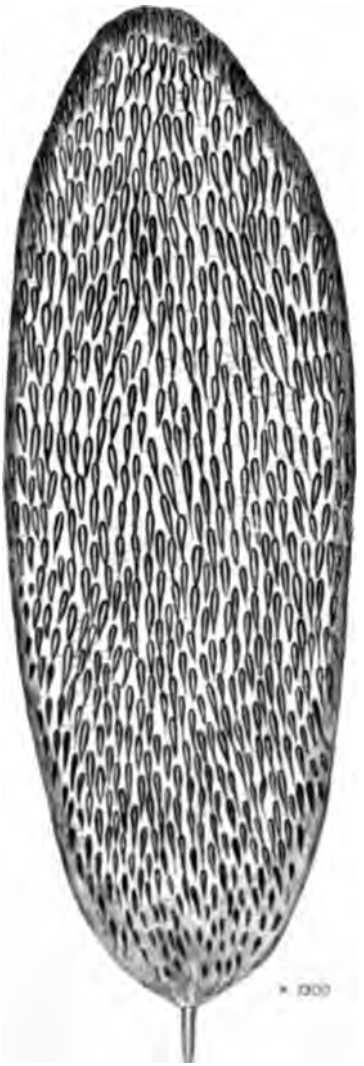
15

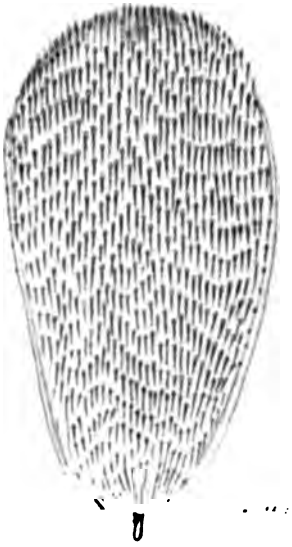


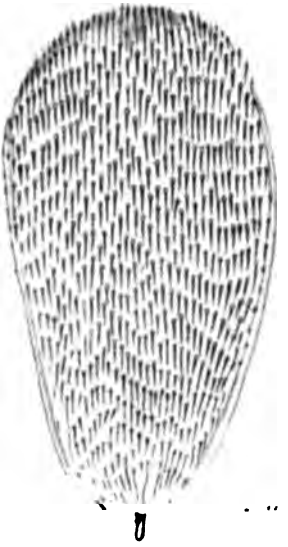
Pl. 68

Templetonia crystallina

Pl. 70.

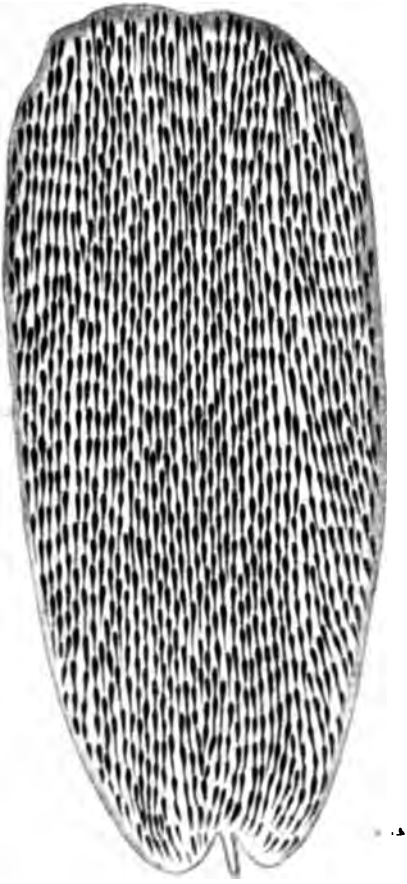


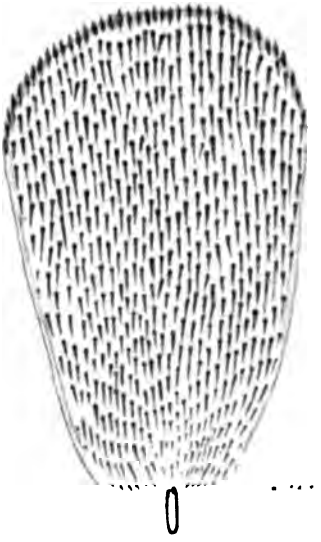


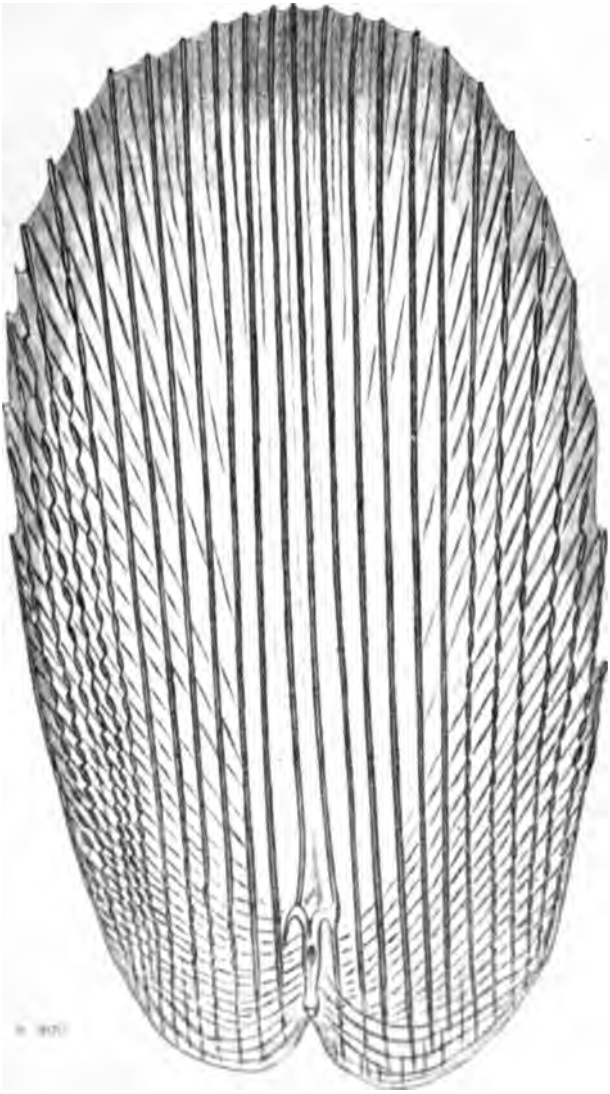


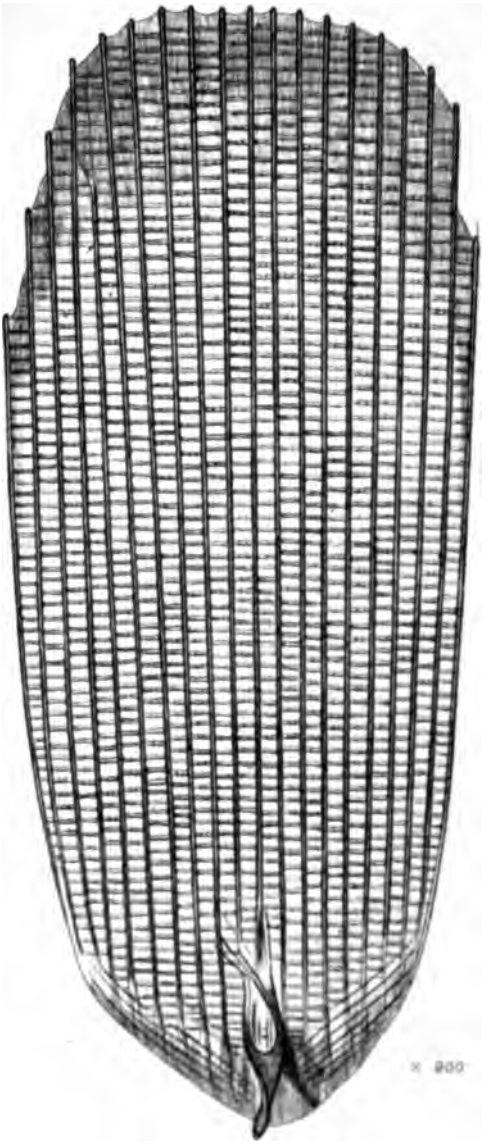
Lepidocyrtus curvicollis (Test.)

Pl 74.









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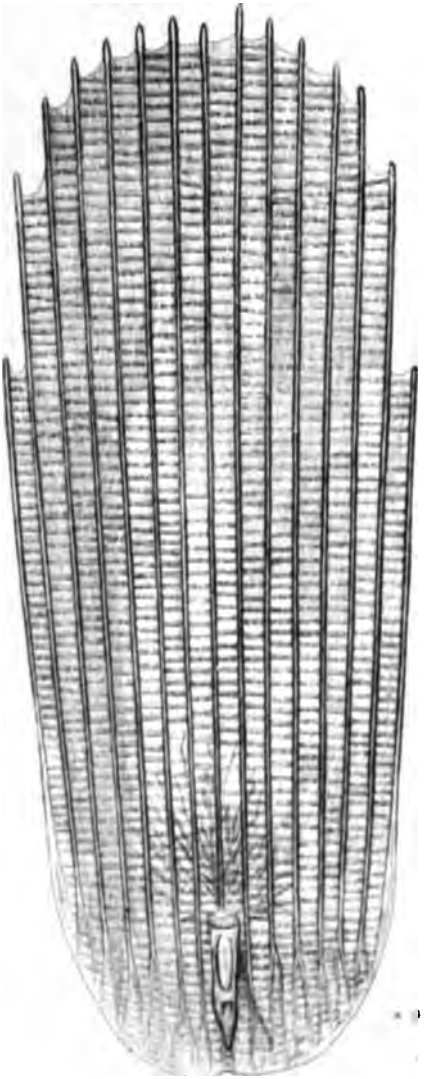

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